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Westcott's New Drill Chuck.

The accompanying illustration represents Westcott's improved double grip drill chuck recently brought out. The object aimed at in this design of chuck is to obtain a very powerful grip on the drill or tap, or such work which the chuck is to hold. Many machinists demand a drill chuck with the grip so strong that a drill will break before it will slip. Others prefer the drill to slip before breaking. These different demands are met in this new chuck. For extra heavy work the drop forged steel tie plate, shown in front of the chuck, is used. This plate acts not only as a clamp, but, having flanges, makes of it a tie plate, preventing the chuck body from spreading or springing.

The tie plate applied to the back of the jaws is independent of their other adjustment. This is accomplished by the tie plate having lateral motion across the face of the chuck body, thereby doing away with the liability of throwing drills or work out of true. When used for extra heavy work, the chuck is centered in the usual manner, then by setting up the set-screws in the tie plate, its holding power is greatly increased.

The set-screws in the tie plate are made for a screwdriver, and do not project, but they can be made with square heads and allowed to project, if so ordered.

By the use of this tie plate the heaviest of work can be done without injury to chuck; *i. e.*, without straining the screw that operates the jaws. This chuck is said to be very powerful for use on bolt-cutting machines, and on screw machines for holding the iron to be threaded with a die, or for any work where a chuck of extra strength is needed. The chuck can be used in the ordinary way without using the tie plate. It is manufactured by the Westcott Chuck Company, of Oneida, N. Y.

Vertical Spindle Milling Machine.

From the introduction of the milling machine until the present time there has been a continual increase in the size of machines and cutters used, experience demonstrating that larger surfaces can be finished and heavier cuts taken than at one time was thought possible (and we are by no means certain that the limit has yet been reached, for a number of large machines are now in use, and giving very satisfactory results).

Our illustration is one of this class, the spindle being placed vertically over a table 8 feet long, 2 feet wide. It is firmly supported by a well-proportioned bed, and provided with suitable automatic feed and stop.

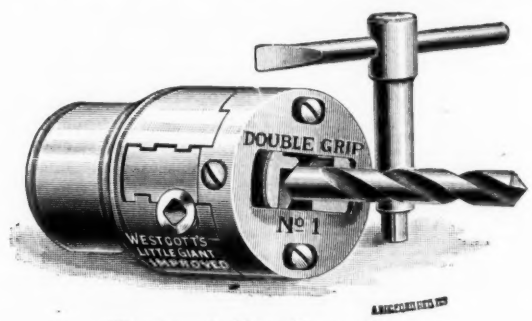
To the bed is attached an upright of a box pattern 2 feet wide, 8 feet 6 inches high, and calculated to withstand torsional strains and vibrations. To it is attached the crosshead which can be easily raised or lowered by means of a screw provided with a graduated dial reading to $\frac{1}{1000}$ ths. To the crosshead is securely gibbed the spindle saddle, which has a movement at right angles to that of the table. The spindle runs in hard bronze boxes, and is driven by a 3-inch belt on a 4-section cone through a train of gearing, giving ample driving power, and suitable speed for various sized cutters.

The machine weighs about 10,000 pounds; it is made by Beaman & Smith, Providence, R. I.

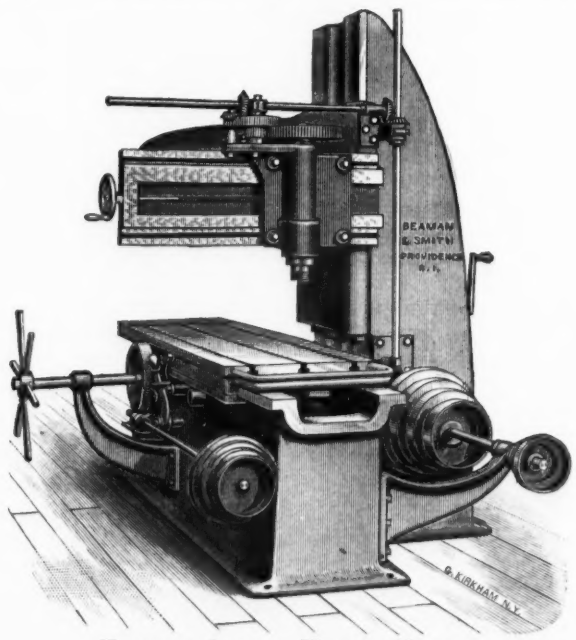
Balanced Slide Valves.

BY B. CRANK.

Persons who have designed and put into use slide valves of sufficient size to meet the requirements of modern engine practice, as to piston speed and steam pressure, have at once recognized the stern necessity for a balanced valve. But there is a large class of persons, consisting of engineers and engine owners, who think that the plain D slide valve is the only good valve, and that the many kinds of balanced valves in use are not called for, and are generally useless complications. There is also a number of persons who, seeing the need of balanced valves, have undertaken to invent them, before having fully realized the difficulties which must be overcome to make them a success, and the result has been a large number of alleged balanced valves that are very little, if any, better than the common D valve. It is the purpose of this and following papers to explain the need for balanced valves, and point out the practical difficulties to be overcome in the construction of a successful valve.



WESTCOTT'S NEW DRILL CHUCK.



VERTICAL SPINDLE MILLING MACHINE.

In 1883, at the spring meeting of the American Society of Mechanical Engineers (see AMERICAN MACHINIST, June 2, 1883,) Prof. S. W. Robinson presented a paper entitled, "Back Pressure on Slide Valves," which should be carefully studied by every person who is called upon to design slide valves. In that paper is presented the results of experiments made to determine the pressure of a valve upon its seat, when acted upon by fluid pressure tending to hold it down. The apparatus used is shown in Fig. 1 (page 2). The plates *A* and *B* had their surfaces fitted together by grinding until they had a good contact. They are enclosed in a chest *C* to which steam could be admitted through pipe *G*. The lever *E* serves as a scale beam to weigh the force required to lift plate *A* from its seat. The cavity under plate *A* can be taken to represent the exhaust cavity in a D valve. With this apparatus they experimented, using steam at different pressures from 5 to 90 pounds, and the results showed that the pressure of the valve upon the seat was much greater than the product of the area of the cavity under the valve multiplied by the pressure above it, and yet the pressure holding it down was not as great as the total area of the plate multiplied by the pressure. This indicated that the steam must get between the surfaces in an imperceptible film, and tend to separate them, but as it worked toward the cavity it lost some of its pressure, and by the time it reached there the pressure had fallen to a point as low as that within the cavity. The diameter of valve *A* was 6″; the cavity under it 2.1″. With pressure of 75 pounds in the chest, and atmospheric pressure within the cavity, it took 787.5 pounds to balance the plate on its seat. At 75 pounds per square inch it would require an area of 10.5 square inches to balance the valve; that would require a circle 3.7″ diameter. To make it more plain, suppose the pin *J* was prolonged downward, and had a piston 3.7″ diameter, on the end of it, fitted to a cylinder; it would require a pressure of 75 pounds per square inch on the piston to balance the valve.

The visible cavity under the valve is only 2.1″ diameter, therefore it is plain that the effective cavity is much larger. The area of 3.7″ diameter in this case would be what Prof. Robinson calls the "equilibrium area," because that area is what would be required to balance the valve, if acted on by the same pressure per square inch which is in the chest. The equilibrium area varies with the pressure, being larger with greater pressure. The valve experimented with was circular, but formula was deduced for rectangular valves, which is probably near enough correct for practical use, because in actual practice the imperfect fit of slide valves makes considerable difference in the equilibrium area, as also does some other causes, which will be pointed out later.

We will now consider the case of a plain D valve. For a cylinder 11½″ diameter and piston speed of 600 feet per minute, the cylinder ports should be 10 square inches area. Ports, 1″x10″; exhaust port, 2″x10″; lap, 1″ for a ¾ stroke cut-off; width of valve, 12″; travel, 4″. Referring to Fig. 2, we will assume that the valve has opened to exhaust enough to reduce the terminal pressure to atmosphere, and at the other end compression has only just commenced, therefore we can consider the distance $K = 6''$ as being exposed to exhaust. By the formula the equilibrium area for that position is 82 square inches, which, at 100 pounds gauge pressure, would be 8,200 pounds required to balance the valve. Take next the position shown in Fig. 3; the valve has opened enough to admit steam into the cylinder to the same pressure as that in the chest. The equilibrium area for this position is 63 square inches. The two positions shown are the two extremes of its unbalanced moments. The difference in equilibrium for the two positions is seen to be 19 square inches, and this by 100 pounds gauge pressure is 1,900 pounds variation in the pressure required to keep the valve in perfect balance.

It must now appear to the reader that it is not possible to balance the valve by pressure against a balance ring or diaphragm of fixed area, because an area that would be just right for position Fig. 2 would lift the valve off its seat in position Fig. 3, and an area right for Fig. 3 would allow it to be out of balance 1,900 pounds in position 2. This only leaves the choice of three conditions, viz., vary the extent of area acted on by a constant pressure; vary the pressure acting on a fixed area, or be contented with a valve not entirely balanced. Before proceeding to examine the different plans of balancing valves we will demonstrate the desirability of having them balanced. The equilibrium area for position 2 is 82 square inches, and for 3 is 63 square inches, and it will be a fair average to say 72 square inches. 72x100 pounds equals 7,200 pounds actual average pressure of the valve upon its seat while in operation. The co-efficient of friction for slide valves will average .1, and that gives us 720 pounds force required to separate the valve. The cylinder for that size valve at 600 feet piston travel per minute would have 100 square inch area. At 40 pounds mean effective pressure it would be 72 horse-power.

Suppose the engine makes 200 revolutions per minute, the valve would make 400 strokes

per minute, and as each stroke is 4″, it would travel 133 feet per minute. This by 720 pounds force to move the valve amounts to 2.9 horse-power, equal about .04 of the engine power to drive the valve.

Suppose the valve to be partially balanced by a ring, and to make sure of the valve keeping to its seat we will make the effective area of the ring two square inches smaller than the least equilibrium area, making it 61 square inches. The largest equilibrium area being 82 square inches makes a difference of 21 square inches, which multiplied by 100 pounds equals 2,100 pounds. Taking about half this for the average unbalanced pressure, say 1,100 pounds, and this by the co-efficient of friction .1 gives 110 pounds force to move the valve, or a little more than $\frac{1}{7}$ that required to move it when unbalanced. Besides this comparatively large saving of power by balancing, there is yet another saving of much greater importance.

The amount of bearing the valve has upon its seat, taking an average of its different positions, is about 34 square inches. Taking the average unbalanced pressure as before at 7,200 pounds, we have 211 pounds pressure per square inch upon its seat, and, as a result, lubrication becomes very difficult. Now, taking the average pressure on the seat for the partially balanced valve as before at 1,100 pounds, the pressure per square inch on the seat is only 32 pounds, and it is then possible to lubricate it, and the durability is very much greater.

It is hoped that the reader has now no doubt of the necessity for balanced valves on steam engines in modern practice, and that any attempt to use the plain D valve on engines designed for modern speeds and boiler pressures must surely result in much trouble, if not entire failure.

In the next paper some of the various plans of balancing valves will be examined.

The New Tower Bridge over the Thames.

The new Tower Bridge over the Thames, now in the course of construction, is attracting considerable interest. The following dimensions have been taken from *Industries:*

The distance between the north, or Middlesex, abutment, and the south, or Surrey, abutment is 880 feet. Two massive masonry piers, each 70 feet wide, have been built in the bed of the river, and have centers 270 feet apart, so that the central or opening span is 200 feet clear. The side or fixed spans are each 270 feet clear. The total length of the whole bridge, including the necessary approaches on both sides of the river, is 2,640 feet. The roadway along the approaches and side spans will be 60 feet wide, but over the central span it will be reduced to 50 feet. Nowhere will there be a steeper gradient than 1 in 40, which compares very favorably with the London Bridge, where the gradient is in some places 1 in 27. Notwithstanding the very large piers necessary for this type of bridge, the sectional area of the waterway is 20,040 square feet, which is rather in excess of the dimensions at London Bridge, where the area is 19,300 square feet. It is stated that no appreciable scour has been observed since the large piers have been built in the river.

The bridge, it is thought, will offer the minimum obstruction to shipping interests, while at the same time it will provide in the best manner for the street traffic, especially for foot passengers, who will be able to pass over the bridge at all times.

With the gradient above referred to, it is not possible to give greater head-room for vessels than 29 feet 6 inches at high water, but this will be sufficient for the bulk of the river traffic. There are, however, on the average, some twenty-two vessels passing per day, which require a much greater head-room than 29 feet 6 inches, and for their benefit the central span of the bridge will consist of two immense leaves, which will weigh nearly 1,000 tons each, and which will be so nicely balanced that they may be easily rotated in a vertical plane by hydraulic machinery on the piers. When these leaves are raised into a vertical position, the head-room will be about 140 feet for the clear width between the piers, which will be ample for all the vessels which navigate this part of the river. While the bridge remains thus open, all vehicular traffic will be suspended, but, in order not to interrupt foot-passengers crossing the bridge at all times, there will be provided two permanent gangways over the central span, at a height of about 140 feet above high water. These will be about 12 feet wide, and at each end there will be large hydraulic hoists for the convenience of people using these high level footways.

The large amount of work entailed in building this bridge will be apparent from the fact that about a quarter of a million cubic feet of stone, besides some 70,000 cubic yards of concrete, are required in the formation of the piers and approaches, while it is estimated that not less than 15,000 tons of iron and steel will be used in the superstructure. The machinery for working the opening span and the passenger lifts will consist of two 360 horse-power steam-pumping engines with six accumulators, and there will also be eight hydraulic engines and four hydraulic lifts.

The weight of the steel is taken for the purpose of calculation at 490 pounds to the cubic foot, and a variation of $1\frac{1}{2}$ per cent. above and below the weights estimated from the dimensions, as shown on the drawings, is allowed by the specification. A tensile strength of 27 to 32 tons per square inch is specified, with an elongation of at least 20 per cent. in a length of 8 inches. The contraction of sectional area at fracture is required to be at least 30 per cent., and the limit of elasticity is not to fall below 14 tons per square inch. The customary bend test requirement is thus specified: Strips from all plates, bars, etc., cut lengthwise or crosswise, and having a minimum width of $1\frac{1}{2}$ inch, shall, after being heated uniformly to a low cherry-red, and cooled in water having a temperature of 82° F., bend double when cold to a curve whose inner radius is equal to one and a half times the thickness of the sample under manipulation.

The material is to be Siemens-Martin steel, and the usual requirements as to freedom from scales, blisters, laminations, cracked edges, and surface defects of every kind are duly specified. Every plate and bar is moreover required to bear a distinguishing number, for obvious reasons, and to be also branded with maker's name and trade mark. Special care is taken with regard to bending of plates and bars in the girder yards. Where practicable, cold bending is resorted to. When this cannot be done, and heating becomes necessary, great care is taken to prevent any abrupt termination in the line of heat, whilst the dangerous limit of temperature known as "blue heat," which ranges from 400° to 600° F., is at all times carefully guarded against. The usual requirements as to annealing are duly specified.

The rivet bars are of Siemens-Martin steel. The tensile strength is required to range from 26 to 30 tons per square inch, with an elongation of at least 20 per cent. in a length of 8 inches. In the bend tests, either cold or after tempering in water of 82° F. at a dull red heat, the bars are required to stand without fracture to a curve whose inner radius is equal to $1\frac{1}{2}$ times the thickness of the bar. The rivets are closed by hydraulic power, except under circumstances necessitating hand riveting. No rivet hole is permitted to be nearer the edge of any plate or bar than the diameter of the rivet.

The testing of the cast-iron is provided for by running from each cast two bars 1 inch square by 3 feet 6 inches long; these bars are required, when placed on solid bearings 3 feet apart, to stand without fracture a load of 784 pounds at the center; the deflection in the center is to range between 0.65 and 0.85 of an inch. All plugging, etc., of castings is, of course, peremptorily forbidden. For the purpose of calculation, the weight of 1 cubic foot of cast-iron is fixed at 448 pounds.

Cast-steel is required to have a tensile strength ranging from 28 to 32 tons per square inch, whilst an elongation of at least 13 per cent. in a length of 2 inches is specified. The bend test is made by planing a piece to a section of 1 inch square, and bending it cold to a curve of $1\frac{1}{2}$ inch radius, so that when relieved it shall stand at an angle of 90°.

All steel castings are hammered well previous to acceptance, in addition to being subjected to careful examination for flaws or defects. Large castings are raised to an angle of 60°, and then allowed to fall on a ground having a hardness and resistance equivalent to that of an ordinary macadamized road. For the purpose of measurement, one cubic foot of cast-steel is taken as weighing 492 pounds.

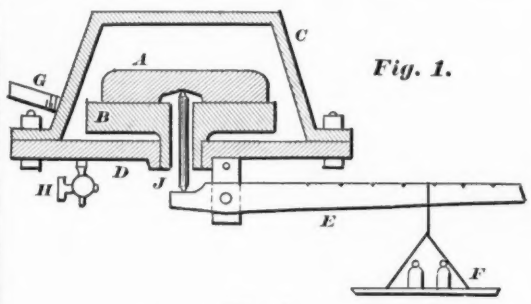
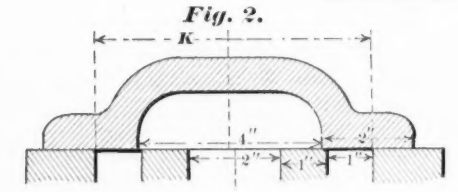


Fig. 1.

Fig. 2.



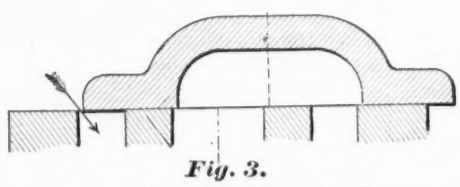


Fig. 3.

BALANCED SLIDE VALVES.—SEE PAGE 1.

The Bridgeport Machine Tool Works.

Some changes have been going on of late at the Bridgeport Machine Tool Works, Bridgeport, Conn., which add considerably to the capacity of the shops, one entire floor which had been previously been let to other parties now being filled with the best and most improved tools, and devoted to the business of getting out machine tools. The special rush seems to be mainly on the heavy turret head machines and boring mills, which have been illustrated in our columns, though there is a lively demand for all kind of tools built by the company.

The additional floor room occupied is 120x38 feet, besides which the portion of the building in which the office is located, and which was formerly only one story high, is now extended upwards, and the drafting-room is now just above the office, its removal from its former location enabling the pattern shop to be much enlarged. Just at the entrance to the new floor is seen a group of machinery, which is somewhat remarkable, consisting, as it does, of three B. & S. universal grinders, two of them of the latest improved design, three universal milling machines of different sizes of the same make, besides numerous other plain milling machines, one of them an upright, several automatic gear cutting machines, besides others, the entire group giving one the impression that an effort is being made to do the best work, and that the means for doing it are not lacking, either from failure to recognize their importance or lack of the means for procuring them.

All the machinery on this floor is not new, however, as some of it has been moved from other departments, that before the enlargement were too much crowded for the most efficient operation, and it is found that, though there are not very many more men employed now than formerly, the output is very considerably increased.

The turret head machines made at these works are here put to good use in the making of studs, bolts, etc., used about the various machines; we noticed one of the larger sized machines on which some studs were being made out of $2\frac{1}{2}$ inch round machinery steel, and a turret tool was reducing this stock to one inch diameter at a single cut, using the automatic feed at the rate of 32 revolutions per inch, so that the chip removed was $\frac{1}{32}$ inch thick and $\frac{3}{4}$ inch wide, a single cutting tool being used, set at right angles to the center line of the work. This will, we think, be generally recognized as very heavy work for a turret machine, and leaves very little room for competition by the lathe on work of that character.

A New Method of Making Fused Wire Joints.

It is well known that a joint of any kind in an electrical conductor offers more or less resistance, no matter how well it may be made. The soldered joint, when carefully made, is the most practical and best method of joining conductors yet brought into use. But a poorly-made soldered joint is even worse than a simple twisted joint; for chemical action and electrolytic action are sure to take place if there is the least moisture present. But even in the absence of moisture the resistance of the joint will cause heat, and heat increases the resistance. These effects are quite well known, and it is understood the heating at a joint increases as the square of the increase in the current strength. There is another effect, not so well known, that occurs in an electric circuit wherever two different metals form a contact, as in the case of a soldered joint. This is known as the Peltier effect, and consists of a heating or cooling of the junction, according to the direction of the current through the joint. This effect does not increase in the same ratio as the heating effect, on account of the resistance; for while the latter increases as the *square* of the increase of the current, the Peltier effect increases *directly* as the increase of current. This effect might be utilized, under certain conditions, to partially overcome the heating effect due to the resistance. In the case of a soldered joint where the solder completely covers the copper, as it will do if the soldering has been well done, the current passes from copper to solder, and from the solder to copper again, and the Peltier effect is neutralized; but if the joint is poorly made the heating effect is greatly increased. In order to avoid these difficulties, or at least to overcome them as much as possible, Frederick J. Smith, an English electrician, has made use of fused joints, and claims that his experiments, extending over a number of months, prove that fused joints wholly prevent the occurrence of these effects. The method of making the joints consists in the use of an oxyhydrogen blow-pipe flame for fusing the wires together. A V-shaped groove is cut in a piece of fire-brick, or a piece of hard quick-lime; the ends of the wires are placed side by side in the groove, and the flame of the blow-pipe is directed upon them until the ends fuse together, which they will do in about the time required to solder a similar joint by the usual methods employed. Care must be taken not to prolong the heating after fusion is complete; for if the heating is continued much after fusion, the copper is suddenly converted into minute globules, which scatter about and leave a thin place where the joint should be. By this method joints can be made in large wires. No flux is required, nor is it necessary to clean the wires before the heat is applied.—*Practical Electricity.*

A manufacturing firm would like to know the amount deducted each year by those engaged in the machine business for the wear and tear of machinery. It is a matter of considerable importance, and we do not doubt but there are others who would like to know. There may not—probably is not—uniformity in this respect, but we shall be glad of information that will throw light on the general practice of machinists in regard to the assumed deterioration of machinery.

Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B. GRANT.

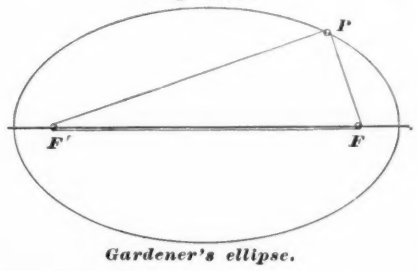
FOURTEENTH PAPER.

138.—ELLIPTOGRAPHS.

There are a multitude of elliptographs, or instruments for drawing the ellipse, but only two of them are of practical application in this connection.

The simplest known elliptograph consists of a couple of pins, a thread, a pencil, and a stock of patience. The pins are inserted at the foci, as in Fig. 123, and the curve is drawn by moving the pencil with a uniform strain against the string. After a number of trials, depending in number on the skill of the draftsman, the curve may be induced to pass

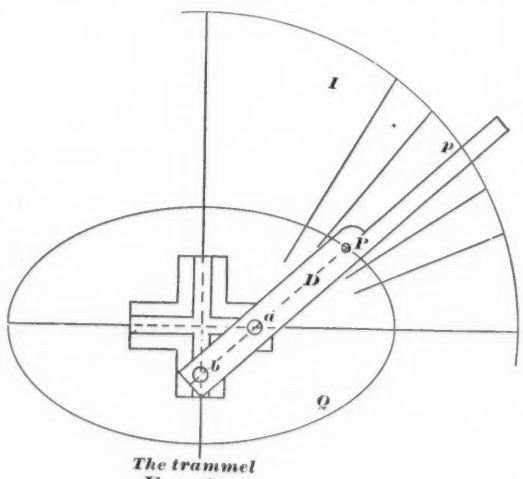
Fig. 123.



Gardener's ellipse.

through the desired points. The best result will be obtained by the use of a well waxed thread running in a groove near the point of a hard pencil. The pencil should be long, and held by the end, so that the strain on the string will be uniform, for the elasticity of the string is the greatest source of error. This "gardener's ellipse" will generally be accurate enough for a tulip patch, but should not be relied upon for mechanical purposes, unless one or more points between the apices are tested and found to be correct. If the two pins and the pencil are circular, and of the same diameter, the accuracy of the ellipse is independent of their diameter.

The best elliptograph is the "trammel," Fig. 124, which takes a variety of shapes, but which in its simplest condition consists of a cross, with two grooves at right angles, and a bar *D* with two pins *a* and *b*, and a tracing point *P* placed in line. The distance *Pb* being set to the major semi-axis, and the distance *Pa* to the minor semi axis, the point *P* will trace the ellipse if the pins are confined to move in the grooves. If carefully made, the instrument works with great precision, is easily handled and set, and, if the curve drawn is not very flat, it may be inked. The cheap wooden trammel should not be tolerated, for the string and two pins cost less and are more reliable.



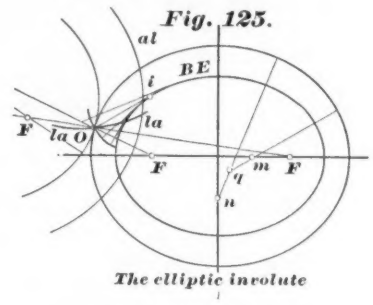
The trammel

Fig. 124.

139.—APPROXIMATE CIRCULAR ARCS.

If a well-made trammel is not at hand, the best plan is to draw the ellipse with a string, through several constructed points, and then to ink it by finding centers for approximate arcs, as shown by Fig. 125. An arc from a center *m* on the major axis, will coincide very well with the curve near the major apex, a similar arc *n* from a center on the minor axis will serve near the minor apex, and a third center *q* can be found for an arc to join the first two. More than three centers will seldom be required, and when the ellipse is not very flat the two centers on the axes will be sufficient.

Fig. 125.



The elliptic involute

140.—FOUR CENTER ELLIPSE.

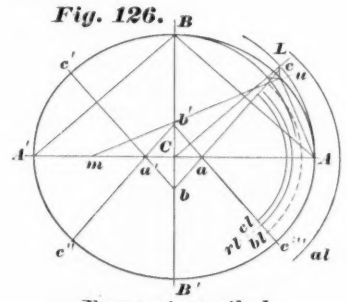
When the ratio of the axes is not less than eight to ten, as is generally the case, a practically perfect ellipse may be drawn from four centers by the following method.

Draw the line *CL*, Fig. 126, parallel to *A'B*, and construct the point *u* on the ellipse by the method of (137). Find a point *a* on the major axis, from which an arc from *A* will pass through *u*, and it will be the major center. It may be found by trial, or by drawing *um* at right angles to *uA*, and bisecting *Am* in *a*.

Through *u* draw *ac* at right angles to *AB*, and its intersection with the minor axis will be the minor center *b*. Lay off *Ca'* and *Cb'* equal to *Ca* and *Cb*, and draw *bc'*, *b'c''*, and *b'c'''*.

From the centers *a* draw the arcs *cAc'''*, and *c'A'c''*, and from the centers *b* draw the arcs *cBc'* and *c''B'c'''*.

Fig. 126.



Four center method

Lines that are parallel to the pitch line, such as the addendum, root, clearance, and base lines, are to be drawn from the same centers.

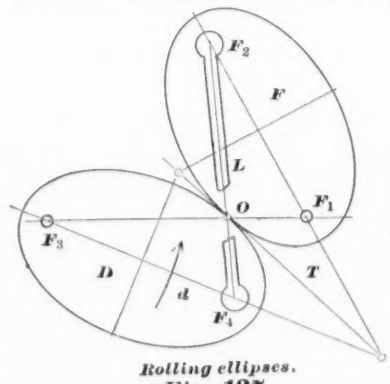
141.—ROLLING ELLIPSES.

When two equal ellipses, Fig. 127, are arranged to revolve on their foci as centers, with a center distance equal to the major axis, they will roll together perfectly, and be fitted to act as the pitch lines of gear wheels.

When the driver *D* turns in the direction of the arrow *d*, it will drive the follower *F* by direct contact of the pitch ellipses, but when turning in the other direction with respect to the follower, as it must during half of its revolution, it has no direct driving action, and the follower must be kept in contact by some other force.

As the two ellipses roll together, the free foci F_3 and F_4 will always move at a constant distance apart, equal to the distance between the fixed foci, and therefore they may be connected by the link *L*.

The center line of the link will always cross the fixed center line at the point of contact of the ellipses, and the tangent *T* at that point will pass through the intersection of the axes.



Rolling ellipses.

Fig. 127.

142.—SPACING THE ELLIPSE.

As the ellipses roll together it is essential that the axes come in line, and therefore, if the teeth of one gear are fixed at random, those of the other must be fixed to correspond. If this requirement is satisfied, it makes no difference where the teeth are placed.

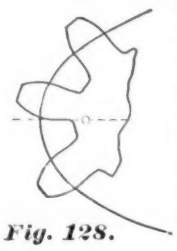
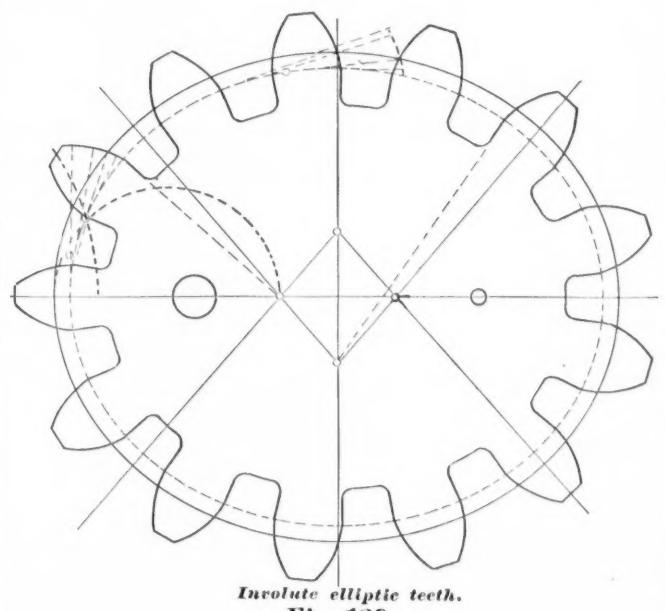


Fig. 128.

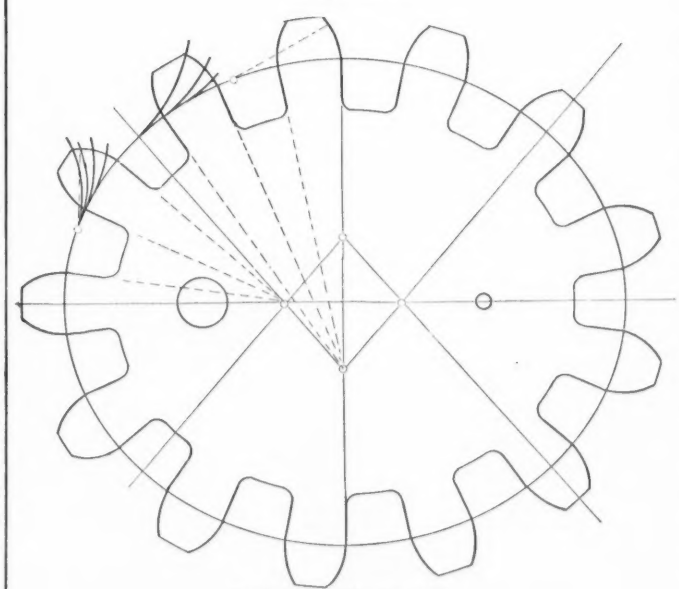
It is, however, very desirable that the two gears shall be exactly alike, so that they can be cut at one operation while mounted together on an arbor through their focus holes, and to do this, it is necessary to start the teeth at different points, according to whether their number is odd or even.

If the number of teeth is even, one tooth must spring from the major axis, as shown by Fig. 128.



Involute elliptic teeth.

Fig. 129.



Cycloidal elliptic teeth.

Fig. 130.

If the number of teeth is odd, the major axis must bisect a tooth and a space, as shown by Fig. 129. In this case, if one of the gears can be turned over, or if its other focus hole can be used as a center, it may have a tooth springing from the major axis.

The simplest method of spacing the ellipse is to step about it with the dividers. If the curve is flat, the dividers should be set to less than a whole tooth, for equal chords will not measure equal arcs of the curve.

But this stepping method, although it is sufficient and convenient for drafting purposes, is wholly unfit for mechanical purposes, and therefore we must have a method that is not dependent on personal skill.

If the ellipse is drawn by means of the trammel, Fig. 124, it can be accurately spaced by means of a graduated index circle *I*, having a diameter equal to the sum of the diameters of the ellipse, for then the center line of the bar will pass over an arc on the ellipse that at the apices is exactly equal to half the arc passed over at the same time on the circle, and that is elsewhere very nearly in the same proportion.

This method is not mathematically exact, but its accuracy is very far within the requirements of practice. The space on the quarter, at *Q*, will be greater than anywhere else, but the maximum error will in general be very minute.

For an example, take an extreme practical case, a gear with axes eight and ten inches long, and with seventy-two teeth. The maximum error, the difference between the longest and shortest tooth arcs, will be not over one five-hundredth of an inch. In the more common practical case of a gear of nine and ten inches axes, and seventy-two teeth, the maximum error is about one two-thousandth of an inch. In both these cases, the difference between the tooth arc at the major apex and that at the minor apex is too small to be readily calculated, but will be about one twenty-thousandth of an inch.

In all cases likely to be met with in practice, the inevitable mechanical errors are greater than the theoretical errors of the method, and it is serviceable on ellipses as flat as three to one.

143.—INVOLUTE ELLIPTIC TEETH.

As in the case of the circular gear, the best form of tooth for the elliptic gear is the involute, and for the same reasons.

The base line of the involute tooth is any ellipse *B E*, Fig. 125, which is drawn from the same foci as the pitch ellipse; the limit point *i* is the point of tangency of a tangent from the pitch point *O*, and the addendum line *a l* of the mating gear must not pass beyond that point.

The method of laying out the tooth and drafting it is so exactly like the process for the circular gear that the description need not be repeated.

The centers of involute elliptic gears can be adjusted without affecting the perfection of the motion transmitted, but, as the focal distance remains fixed, the ratio of the axes will be altered.

The work of drawing the teeth can be much abbreviated by the process illustrated by Fig. 129. Find the centers for approximate circular arcs, preferably by the method of (140), and then consider the gear as made up of four circular toothed segments. It is then necessary to construct but two tooth curves, one for the major and one for the minor segment, and the flanks will be radii of the circular arcs.

The line of action, *la*, Fig. 125, is not a straight line, and it is not the same for all the teeth. It is not fixed when the pitch, point *O* and the line of centers is fixed (134).

144.—CYCLOIDAL ELLIPTIC TEETH.

The cycloidal tooth is drawn, exactly as upon a circular pitch lines, by a tracing point in a circle that is rolled on both sides of the pitch line. The line of action is not a circle, and it is not the same curve for all the teeth.

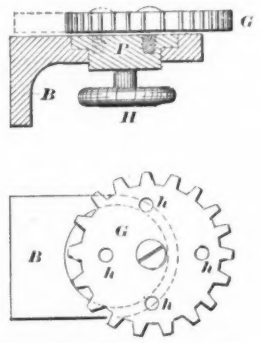
That the flanks shall not be under-curved, the diameter of the rolling circle should not

be greater than the radius of curvature at the tooth being drawn, and when, as usual, the same roller is used for all the teeth, its diameter should not be greater than the radius of curvature at the major apex, the distance *Ch* of Fig. 122.

Fig. 130 shows a cycloidal gear drawn as four circular segments, by the methods of (140) and (83).

A Device for "Catching Threads."

We illustrate on this page a new device for use in cutting threads on the lathe, which is intended to obviate the need of a backing belt, or the usual measuring and chalking operation.



As will be seen by the cut, which gives an elevation and plan view of the device, it consists of a small bracket *B*, which is attached to the inside of the carriage apron in such a position that the center of the face of the wheel *G*, that is fixed to the bracket, will come level with the center of the lead-screw. *G* is a worm-wheel which is proportioned to suit the lead screw, and is fitted to a stud which is fixed in the small plate *P*, eccentrically, so that, by turning the small knurled disk *H*, the wheel *G* can be thrown in or out of gear with the screw.

In the upper side face of the wheel there are holes which are so spaced, with reference to the number of teeth in the wheel, that when the wheel has been turned from one of these holes to the next one by the revolution of the lead screw, the latter has moved just enough to have moved the carriage one inch, if the nut were closed. On the other hand, if the gear is in engagement with the screw with the nut open, and the carriage be moved by hand, one of the holes *h* will come fair with a pin *S* (not shown) at every inch of travel of the carriage. Or, if the screw be in motion, and at the same time the carriage be moved by hand, then the relative motion of the carriage and screw will bring a hole under the pin at each inch of travel of the carriage and the threads of the screw relative to each other.

The pin *S* is fixed in the upper half of the nut, and consequently the nut can be closed on the screw at every inch of travel of the carriage, equivalent motion of the screw, or combination of the two movements.

It follows from this that when cutting screws containing any integral number of threads per inch, the nut can be closed only when the tool has passed over that integral number of threads of the screw being cut: or, in other words, one inch of its length and the tool will strike the thread properly.

The device can of course be applied to almost any lathe using an open nut, and relieves the workman from the necessity of watching marks made on various parts of the lathe without imposing any extra motions upon him. It has recently been patented by E. F. Valiquet, Norwich, Conn.

A Simple Twist Drill Grinder.

Mr. A. K. Rider, a mining and mechanical engineer, of Walden, N. Y., sends us a small box, in which we find a drill grinder that is shown full size in the accompanying cut, Fig. 1, which gives a side elevation, and below a plan view.

The device consists essentially of two pieces of steel, *A* and *B*, which are joined together by the screw as shown, the piece *A* being tight on the screw, while the other piece *B* is loose, but can be clamped by the knurled nut as shown. Diagonally across the inner faces of both the pieces *A* and *B* is a small V groove adapted to hold small twist drills, which are passed through a hole provided for that purpose in the screw. Pains are taken to locate these V grooves so that the angle between them and the side *a* is the same as between them and the side *b*, or, in other words, 45° on each side. When a drill is in place ready for grinding, as shown, the two blocks together measure about one inch in all directions, except that two of the corners are taken off as shown; we presume for comfort in handling it.

When a drill is to be ground it is put into the grooves between the two blocks, and the nut partly tightened up, after which, a little twisting of the blocks upon each other, and of the drill in its place, adjusts it to the proper position, *i. e.*, with the point of the drill just barely projecting from the blocks, and turned in such a way that, as Mr. Rider puts it, "the side or bearing part of the drill is slightly in advance of being parallel with the side surface of gauge." This perhaps may not be very clear to some, but it is plain that, by turning the drill more or less, a greater or less amount of clearance can be given, and a few trials will show what the proper position is better than any one can tell it. The nut is then tightened up, and the drill ground by rubbing the device on an oil stone, first on the side *a*, and then on *b*, until the drill is ground off even with these faces; and when this has been done the lips of the drilll are precisely alike, if the tool has been accurately made. Mr. Rider says it puts a drill in much better shape for work than it is when new, and some samples of drills ground with it and enclosed in the before mentioned box are certainly very well ground. It is intended for drills from the smallest size up to nearly or quite ½ inch.

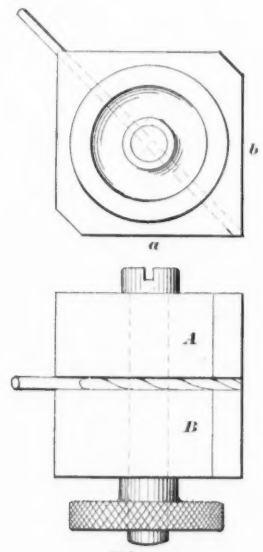


Fig. 1.

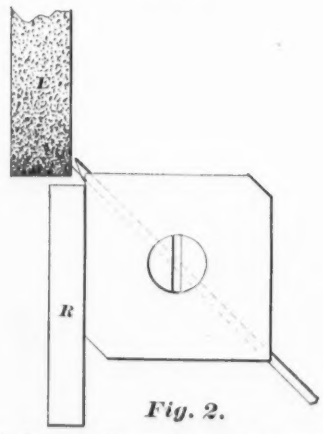


Fig. 2.

A SIMPLE TWIST DRILL GRINDER.

Though Mr. Rider mentions no other way of using this device, except in connection with an oil stone, it has occurred to us that it might be used on an emery grinder by providing a small angle plate, to stand up on the rest usually provided with such grinders, the top portion of this angle plate being represented by *R*, Fig. 2, the surface against which the device is held being vertical and parallel with the side face of the emery wheel *E*. Then by placing the surfaces *a* and *b* successively against the rest, and keeping them there until the wheel ceased to grind, the same object would be attained without wear on the blocks. Of course in this use of it it would be necessary to have the drill project slightly, as shown, and all end motion of the wheel spindle would have to be avoided in order to do accurate work. Any angle of the cutting lips desired could be secured in this way too, because to change the angle it would be necessary only to swing the rest or angle plate round, and clamp it at an angle, instead of parallel with the side face of the wheel. Mr. Rider says that any of our readers is free to make this device and add it to his kit, and we think that it will prove a valuable addition to the kit of a man who has much small drilling to do.

Force, Motion and Work.

BY PEDRO.

EIGHTEENTH PAPER.

CONSERVATION OF FORCE AND WORK—EFFICIENCY.

The principle of work is very useful in making various calculations in designing machinery, especially such as relate to the transmission of power by gears, belting, etc. These calculations are often much simplified by taking advantage of a principle known as the *conservation of work*. This expression means that there is no work lost in the sense of being annihilated, or disappearing without producing some effect. The sum of all the effects produced is always equal to the amount of work expended. For example, take a simple case, illustrated in Fig. 58. Here the weight w is raised by winding the rope F, to which it is attached, around a drum whose radius is B, while another rope E is unwound from another drum, whose radius is A, the active agent pulling on this rope an amount represented by f_1. The two drums are rigidly fastened to each other. Let C be the distance through which the active agent exerts the tension or pull f_1, and therefore the work performed by it is $f_1\ C$ (Equation 60 (II) sixteenth paper). In like manner, to raise the weight w through a height D requires an amount of work which is equal to $w\ D$, w being the static force of gravity, against which the weight is lifted. Now, the effect produced by the active agent over the space C is transmitted through the drums to the weight w, and causes it to be elevated. As the force f_1 is the only cause acting to raise the weight w, the two effects or work here represented are therefore equal to each other (provided that there is no physical resistance), since the effect represented by $w\ D$ is simply that produced by f_1 and transmitted through the ropes and drums to the weight w. Hence we may write,

$$67 \ldots\ldots\ldots f_1\ C = w\ D.$$

That is, the amount of work which must be performed by the active agent is always equal to the effect produced upon the passive body, and is equal to the resistance of that body multiplied by the distance it is moved against that resistance.

But it requires a certain amount of work to overcome the physical resistance. This resistance consists in the friction of the journals of the drums, and in friction between the fibers of the ropes in being bent over the drums. There is also more or less friction of the moving parts in passing through the air. This is considerable when the speed is high. Let us represent the work required to overcome all of this resistance by $R\ s$, then, according to the principle of the conservation of work, we will have,

$$68 \ldots\ldots\ldots f_1\ C = w\ D + R\ s.$$

This equation represents, in a general way, what takes place in all cases where work is performed; that is, the work is divided into three parts. First we have the work $f_1\ C$, performed by the active agent, and this is called the *expended work*, because it requires an expenditure of this amount of work to produce the desired effect. Second, we have the *useful work*, $w\ D$, which is the work required to produce the desired effect (exclusive of friction)—in Fig. 58, that of raising the weight w. Third, $R\ s$ is the work required to overcome the physical resistance, and it is called the *lost work*, because this part of the work represents an actual loss, and is, generally speaking, any effect produced which is not wanted, but enters as an item in the form of an unavoidable evil.

There are a great many causes for the loss of work, while it is being transmitted from one place to another. We have already mentioned friction on wearing surfaces, friction of moving parts in passing through the air, the resistance offered by ropes and belts to being continually bent ever the pulley, etc.

Work also disappears in the form of heat. James Prescott Joule discovered by experiments from 1840 to 1849 that work and heat are mutually convertible; that is, that heat can be produced by work, and on the other hand, that work can be done through the medium of heat. In his experiments Joule found that one thermal unit of heat, by Fahrenheit's scale, can be produced by the expenditure of 772 foot-pounds of work, and *vice versa*, every thermal unit of heat, when converted into work, will produce 772 foot-pounds. This number—772 foot-pounds—is called Joule's *mechanical equivalent of heat*. Some experiments made by Joule since 1870 have resulted in a little larger value for the mechanical equivalent of heat, viz., 772.43 foot-pounds. The steam engine is an illustration of this principle. The steam contains less heat when it is exhausted from the cylinder than it does when it is admitted, and the difference or the *quantity of heat* lost by the steam, multiplied by the mechanical equivalent of heat (772) gives the amount of work done by the steam.

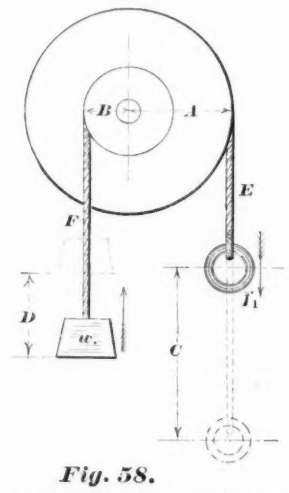


Fig. 58.

FORCE, MOTION AND WORK.

We see, then, that the heating of parts of machinery, such as journal boxes, is a source of the loss of work, because it is work, converted into heat, that supplies that heat; hence, the useful work performed is reduced in proportion to the amount of heat developed, or, if the useful work is to remain the same, then the expended work must be increased by the same amount.

Electricity is another form in which work disappears. Belts usually generate more or less electricity, which consumes a certain amount of the expended work, and therefore this sometimes forms an item in the lost work. There are numerous examples of the mutual convertibility of work and electricity. Our streets are lighted as a result of the work expended by the steam engine or other motor, being converted, first into electricity, and then into heat and light. The electric motor furnishes an example of converting electricity into work. The work of the engine is converted into electricity, and at a distant point in the same circuit the electricity is again converted into work through the medium of the electric motor.

In whatever form (or forms) that work may disappear or be transformed the sum of the useful and the lost work is always equal to that expended, as represented in Equation 68. This is the principle of the *conservation of work*.

When work is expended upon any body in such a manner that the same work is available, at any future time, in performing work upon some other body, the work so expended is said to be *stored* in the body. For example, in Fig. 58, the work $w\ D$, which is expended in raising the weight w, is stored in the body thus raised, because the weight can be released at any time, and in falling

through the height D it is capable of performing an amount of work upon any other body which is the same as that which was previously stored in it. The work represented by $R\,s$, in Equation 68, is not stored in the body w, for it is expended upon other bodies in overcoming friction, etc., and is beyond recovery; it is lost. In the same manner work is stored in the heavy weight of a pile-driver when hoisted. Work is stored in the steam of a locomotive in the form of heat, and is gradually used in drawing the train. Work is stored in a spring when "wound up," as in a clock, where it is gradually used to keep the clock in motion. Work is also stored in a moving body. Equations 66, seventeenth paper, give the amount of work required to set a free body in motion, and if there is no physical resistance no work is lost, but all the work so expended is retained by the body; in other words, it is stored in it. If V_1 is the velocity of the body, then by Equation 66 (III.) the work stored in it is $\frac{F_1\ V_1}{2}$. If this work is transmitted to a second body at any time without loss by friction then we may write the equation

$$69 \ldots\ldots\ldots \frac{F_1\ V_1}{2} = f_2\, s_2$$

in which f_2 is the resistance which the second body offers to motion, and s_2 is the distance through which that resistance is overcome by the first body. From this equation we get

$$70 \ldots\ldots\ldots f_2 = \frac{F_1\ V_1}{2 s_2} = \frac{W_1}{s_2}.$$

Rule 70.—That is, the resistance which a moving body can overcome is found by *dividing the work stored in the moving body by the space through which the driven body is moved.*

This rule, of course, is true only under the condition that all the work stored in the first body is given up or expended on the second body in producing motion. After the body has thus given up its work it will be at rest, since it will have lost all the elements of motion.

If $s_2 = v_2 = \frac{V_1}{2}$, the average velocity of the first body, then $f_2 = F_1$. That is, the resistance which a moving body can overcome, in the unit of time, over a distance represented by its average velocity, is equal to its dynamic force, as stated in the fifteenth paper.

According to the law of the conservation of work, if the body meets with resistance, and its motion is retarded, it will not come to rest until all the stored work has been given up. In other words, by virtue of its motion the body is capable of doing an amount of work which is equal to that previously stored in it. This is readily proved by referring to Equation 23 (VI.), fifth paper, from which we get the space passed over while the body is being brought to rest; *viz.*, $s = \frac{V^2}{2a}$ since the initial velocity $V_2 = V$, the same as in Equation 66 (III.) and the final velocity $V_1 = 0$. Combining this with Equation 46 we have for the work required to bring the body to rest,

$$W = \frac{w\ V^2}{2g},$$

which is the same as Equation 66 (III.), the work stored in the body at its maximum speed, from which it was reduced. Hence we see that the work stored in a moving body is also the amount of work which must be expended in opposition to it, to bring it to rest, or, in other words, the work that the body can do before it is brought to rest. This fact is illustrated in any moving body, a train, for example; the train will not stop as soon as the steam is shut off, but it will continue to move until the amount of work performed in overcoming the resistance is exactly equal to the work stored in the moving train, as expressed by Rule 66 (III.)

The law of conservation applies to force as well as to work. When a body, which is moving with a given dynamic force, is opposed or resisted in its motion by another body, then some of the force of the first body is given up to overcome the resistance, and whatever force may be lost by the first body is added to that of the second, unless some of it is otherwise expended in the transmission of it. This has already been illustrated and proved in the fifteenth paper.

The principle of the conservation of work may also be illustrated by water being pumped through a pipe and delivered into a tank. Suppose that the pipe has a number of places between the pump and the tank where some of the water leaks out and is lost. Here the amount of water delivered to the tank is less than that which passes through the pump, but the actual quantity of water has not been reduced, that is, none has been annihilated. The difference between that passing through the pump and that *stored* in the tank simply represents the amount lost through leakage, evaporation or otherwise. In machinery the leakage consists in the work lost by friction, heating, etc. If there were no "leakage" then the amount of work delivered at its destination would always be equal to the amount expended.

All machines are more or less imperfect in the proportion that work is lost in transmitting it. The degree of perfection is measured by what is called the *efficiency* of the machine. The efficiency is the amount of work transmitted to its destination, or the useful work performed, and is expressed in the fractional part of the work expended. Thus, if the useful work performed by a machine is 750 foot-pounds, and the expended work is 1,000 foot-pounds, then the efficiency of the machine is $\frac{750}{1000} = \frac{3}{4}$, which means that only three-quarters, or seventy-five per cent. of the expended work, is realized in producing the useful effect. The remaining twenty-five per cent. is a loss, as it is required to overcome the friction and other resistances of the machine.

Representing the efficiency generally by E, then in the example, Fig. 58, we have:

$$71 \begin{cases} \text{I.} \ldots E = \dfrac{w\ D}{f_1\ C}, \text{ or, substituting the value of } w\ D \text{ from Equation 68, we have:} \\ \text{II.} \ldots E = 1 - \dfrac{R\ s}{f_1 C}. \end{cases}$$

Rule 71.—To find the efficiency of any machine.

I.—Divide the useful work done by the work expended, or

II.—Divide the lost work by that expended and subtract the ratio from unity.

The lost work may be found from Equations 68 and 71 (II) which give:

$$72 \begin{cases} \text{I.} \ldots\ldots\ldots R\ s = f_1\ C - w\ D. \\ \text{II} \ldots\ldots\ldots R\ s = (1 - E) f_1\ C. \end{cases}$$

Rule 72.—To find the lost work:

I.—Subtract the useful work from that expended, or

II.—Subtract the efficiency from unity and multiply the remainder by the expended work.

For a machine to be perfect, its efficiency must be unity; that is, the useful work performed must be equal to that expended, in which case there would be no loss. Of course this condition can never be realized in practice, but the nearer the efficiency approaches unity the nearer the machine approaches perfection. In making calculations when designing new machines, the work required to overcome the resistance is often an unknown quantity, and we have no means of determining this, hence the calculations are usually made on the assumption that there is no resistance, and an allowance is then made of twenty-five per cent., more or less, according to the judgment of the designer. For example, if the work is to be transmitted through a long train of gears, we simply get an estimate of the amount of useful work to be done at the end of the train, add twenty-five per cent. to it—supposing this to be the estimated allowance for overcoming the physical resistances—the result will be the work which must be expended to produce the desired effect.

The "Sweetland" Independent Chuck, with Reversible Jaws.

The cuts herewith represent a new line of lathe chucks, now being placed on the market by the Hoggson & Pettis Manufacturing Company, New Haven, Conn.

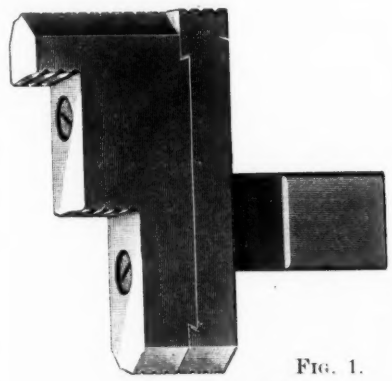


FIG. 1.

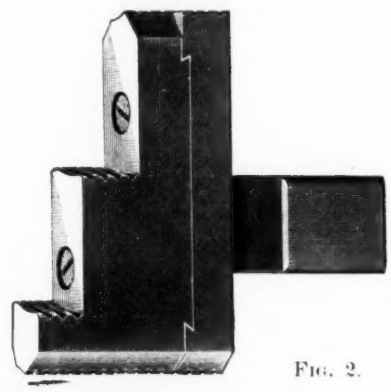
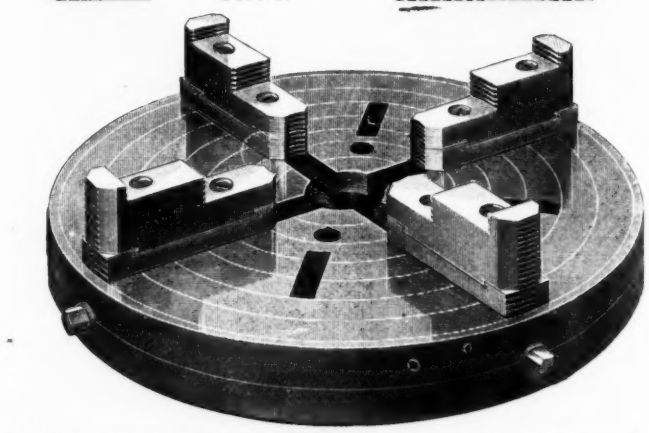


FIG. 2.



THE "SWEETLAND" INDEPENDENT CHUCK WITH REVERSIBLE JAWS.

This chuck, it will be observed, is somewhat thinner than it is customary to make chucks of this type. It is made so because it is believed that this feature is valuable, in that it permits bringing the work nearer the head-stock of the lathe. At the same time the parts are strengthened and made extra heavy at important points, such as at the pinion head and at other points, so as to reduce the danger of breakage to a minimum, and provide stiffness and strength. The pinions are of steel, hardened, and the construction throughout is with a view to withstanding hard usage.

In order more clearly to explain the construction of the chuck, we have introduced detail cuts of the jaws (Figs. 1 and 2). These jaws, which we believe are substantially the same as are used in other types of the "Sweetland" chuck, are of steel, hardened. It will be seen that they are made with a transverse dovetail, which holds the outer and the inner sections together, and by means of which the outer section can be removed by taking out the small screws and replaced in a reversed position, without removing the jaws from the chuck, giving three sets of jaws in one, which the makers term No. 0, No. 1, and No. 2. An inspection of the detail cuts, in which the jaws are shown reversed in position, and of the principal cut below them, will illustrate.

Fig. 1 represents the jaw used as a No. 0, or common jaw, and Fig. 2 shows the jaw reversed. In the principal cut the chuck is represented complete.

The small screws, shown as holding the two parts of the jaws together, do not take the thrust against the jaws; that is taken by the dovetail. These screws are necessary to prevent the outer section from moving sideways on the inner section. The jaw appears to be as nearly like a solid jaw as it is practicable to make it.

The engraving cannot be taken as representing any especial chuck, as they are made in a variety of sizes.

What Civility Will Do.

How far a little civility will go in making things work smoothly may be seen at the entrance to the platform from which passengers enter the cars of the elevated cable road at the Hoboken ferry. After all, perhaps it is only a verification of the old adage, "Every man to his trade." At the time of day when men are leaving New York for their homes a ferryboat will carry as many passengers whose destination is the "Heights" as will load three or four cable cars, and every passenger—man, woman or child—is anxious to get the first car, although the interval between cars is very short. On the upper platform the space is limited, and if the passengers were allowed to crowd this, as they would do, accidents would be sure to occur; some one would be sure to get pushed through the openings to the cable below. A gateman must be stationed at the gateway leading to the upper platform to keep back the crowd—all eager to get home—when a sufficient number has passed. This gateman is presumably clothed with the authority of a policeman—at least he wears the uniform of one. But he does not manage crowds by virtue of his uniform and club. He does it by sheer good nature, and by knowing how. He is perpetually shutting that sliding gate in a way to cut the crowd in two, and as perpetually smiling and turning around to laugh and chat with the disappointed ones. He is too much of a mechanic to try to dam the passing stream by slamming the gate through it. He quietly insinuates himself in the gateway, and pulls the gate into the place he just occupied, as he steps out. There are ways and ways of parting an eager crowd with a gate. There are a good many railroad companies that would make money by giving their employes—some of them—opportunities to see how this gateman does his duty and keeps himself and everybody else happy.

Test of the Big Crane.

The *Washington Post* publishes an account of the test at the navy yard there of the 110-ton crane built by the Morgan Engineering Works and illustrated in our issues of June 12 and 19. A weight of 110 gross tons, or 246,400 pounds, made up of pig iron piled upon a massive platform, was picked up and carried about with the greatest ease, and the crane worked satisfactorily in every respect. It is stated that the crane, with the iron frame work upon which it is supported, has cost the government $200,000.

The steamship "Empress of India," now in course of construction for the Canadian Pacific Railway Company, is expected to be ready for sea in two months; it is only nine months since her keel was laid. This steamer is the first of three ordered at Barrow for the new route between Vancouver and Yokohama. The dimensions of "Empress of India" and the other two ships are as follows: Length over all, 485 feet; between perpendiculars, 440 feet; breadth (moulded), 51 feet; depth (moulded), 36 feet; tonnage, 5,700 tons gross. The hull is divided into twelve transverse water-tight compartments, and the ship will be so fitted as to be of service in case of war. The engines are of the triple expansion type, of 10,000 horse-power. The cylinders are 32, 51, and 82 inches diameter, stroke 54 inches. The boilers, four in number, are each 16 feet 3 inches diameter, and 18 feet 9 inches long, designed for a working pressure of 160 pounds per square inch.

LETTERS FROM PRACTICAL MEN.

White Lines on Blue Prints.

Editor American Machinist:

Your correspondent, C. P. R., asks for a good liquid for making a white line on blue prints. Like him I have used several liquids without satisfaction, until using permanent Chinese white, water color, which, when mixed to the consistency of cream, can be used with a pen, and makes a good clear white line which will not fade as do the soda solutions, and is not easily rubbed off. I find that the color that comes in tubes is the best, as it always keeps in good condition, and is easily mixed with a little water when wanted for use. A. B. EDDOWES.

Editor American Machinist:

I notice in the Questions and Answers column of your last issue that C. P. R., of Buffalo, N. Y., speaks of trouble he has had in obtaining a satisfactory liquid for marking on blue prints. I have had the same trouble with "soda water" and like substances, and find that a solution of air-slaked lime and water will make a perfectly white line without spreading. It should be mixed thoroughly, and kept well shaken while in use. The best results are obtained when the lime is perfectly white and free from dirt. When dry, the lime, of course, will remain on the surface of the paper, and should be removed by shaking the print vigorously.

J. W. TIERNEY.

Editor American Machinist:

In the AMERICAN MACHINIST of September 11, 1890, column of Questions and Answers (No. 357), C. P. R., Buffalo, N. Y., desires a good liquid for producing permanent white lines on blue prints. If he will use Winsor & Newton's permanent Chinese white he will obtain the best of success. Always shake the liquid well before using. I send you blue print with lines drawn with this ink. I have used it for years, and have never had occasion to find fault with it.

C. E. SIMONDS.

Roxbury, Mass.

[The lines on the print to which our correspondent refers are excellent.]

Editor American Machinist:

If C. P. R. will try lime dissolved in water he will have a liquid that will flow from the pen as easily as ink, and give nice white lines on blue prints. L.

The Cupola Explosion Again.

Editor American Machinist:

I have been in the foundry business for the past twenty years, and must say I have enjoyed reading the experiences of some of my brother foundrymen in regards to the Cassidy & Adler cupola explosion. One thinks it must be there was a loaded shell in the scrap; another thinks too much wind from a pressure blower, etc. Now, if the foreman of foundry would tell us how he charged his cupola, and how and where he lit his fire, and give us an idea how it acted when he was charging, I think we could catch at some idea how it happened.

Some two years ago I was melting in a 45-inch cupola (inside of brick) 6½ feet from sand bottom to charging door. I lit fire at 2 o'clock and charge at 2:30, putting on the wind at 3:30, iron down 3:45. We ran off about 2,000 pounds of iron, when the iron went down through the bottom. We took off the wind to stop up the hole, and the gas or flame on top of the stock settled down into the stock, and for some unknown reason caught at the charging door. Those that saw it said there was a flame of fire went out of the top of the stock fifty feet in the air. The report could be heard for half a mile. It broke out about fifty panes of glass in the ventilator on top of the foundry. We put on the wind, took off the cast all right. If the gas had not gone up through the stock I have no doubt it would have gone through the side of the cupola. I have done the same thing before, but never have had the same experience. If you think this worthy of room in your valuable paper I should like to have you use it. Please do not use my name, for I am not looking for any notoriety.

CONN. MELTER.

Dividing and Drilling an Original Index.

Editor American Machinist:

Some time ago the superintendent of a shop where a great deal of small gear cutting is done came to me with a request something like the following:

"Will you divide the rim of a 20" pulley, and drill it with holes $\frac{1}{10}$-inch diameter, so that we can use it to test our gear-cutting indexes, and correct them, as they wear out of truth of division? The numbers we use most are 20, 21, 22, 23, 24, 25, 26 and 54, these numbers answering also for pinions of 6, 7, 8, 9, 10, 11, 12 and 13 teeth. The indexes are plain steel disks, notched on the edge, about 5" diameter. We will place the pulley and the index on the same arbor. The pin used on the pulley rim will be attached to the short arm of a pointer, which multiplies the variation existing between the two so that it is very appreciable."

As the concern he represented was a good customer, I was bound to say we would do anything we could with pleasure, but I must know about how accurate a job was wanted. Would drilling to the least worn of our milling machine indexes answer?

The look with which he answered this was a study, followed by the remark: "We want it spaced and drilled by hand, and not a copy of your old indexes. We want it so exact that when we have brought our disk to agree with it we can shift it on the arbor and not find a variation of one ten-thousandth inch anywhere."

It is needless to repeat the arguments which I advanced to show that it was impossible to do by hand what I was doubtful of doing by the machine. Rather than oppose a good customer I agreed to make the trial, giving the job to the most careful tool maker we had.

We finished the pulley carefully all over, whitened it in nickel so that it would remain clean, and marked off the face with fine lines, which were to be used in spacing around. About this time it occurred to me that if the spacing was even half good it certainly would be spoiled in drilling the 215 holes. I therefore took the responsibility of not spacing it by hand exactly, but arranged to do the spacing and drilling mechanically, making really an original index. The accompanying sketch shows how it was mounted on a 10" tool maker's lathe carriage. The pieces *B A B'*, Fig. 3, are nicely fitted and gibbed to the rim, as shown by Fig. 1. The knurled head-screws shown on the lower side serve to clamp them in position. *B'* carries the hardened drilling jig, Fig. 4, which can be placed at any point in the width of the face. The piece *A* is moved between the micrometer screws, carried by *B* and *B'*, which are connected together by the steel bar *C*, shown above, so as to be practically one piece. This bar is drilled at regular intervals so that any great change in spacing does not require the adjusting screws to be moved so far as to alter the bearing on the points. The dividing and drilling was accomplished in good time. The man would drill one hole on the starting line, grind a pin so it would just fit through the jig and into the hole, while the parts *B B'* were firmly clamped to the rim; then bring *A* in solid contact with *B*, and clamp it; remove the pin from the bushing, unclamp *B B'*, and move until *B'* came in solid contact with *A*, and clamp. This operation repeated, but without drilling any but the first hole, would carry him around the pulley in about three to five minutes. The first time around would show some variation at the hole, which would be corrected by the micrometer screws. When the spacing was finally reached the man would make a fresh start from the first hole, and go around the pulley ten times without stopping. If, then, the pin entered the hole readily, the division was called right, and the drilling done without making any further change. This was repeated for each set of division, and made an index which is very nearly perfect—certainly as good as we could have done by hand, and the spacing, being purely mechanical, did not involve such trying of the eyes and nerves as to make the job one to be dreaded by the tool maker.

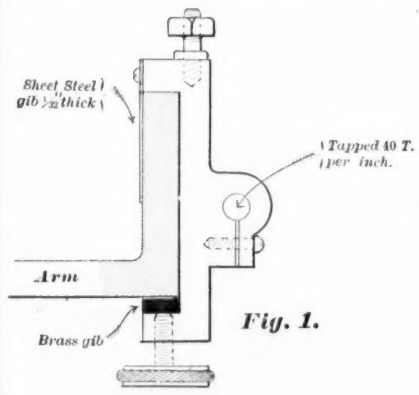


Fig. 1.

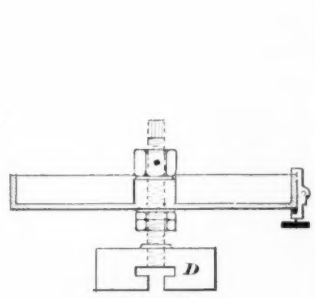


Fig. 2.

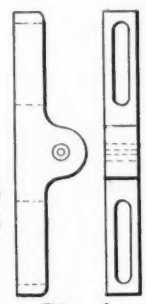
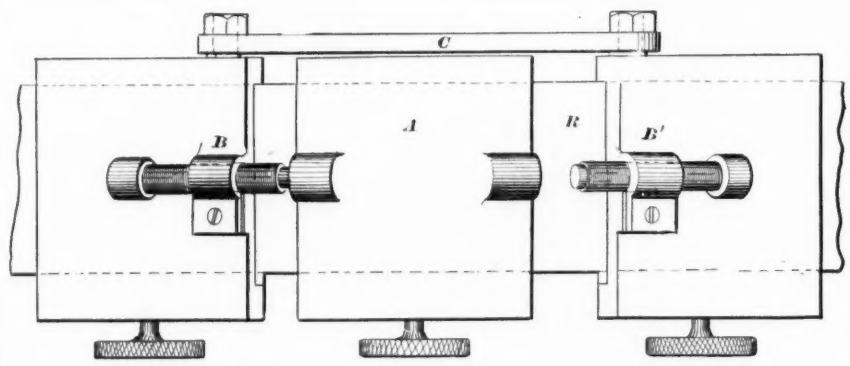


Fig. 4.



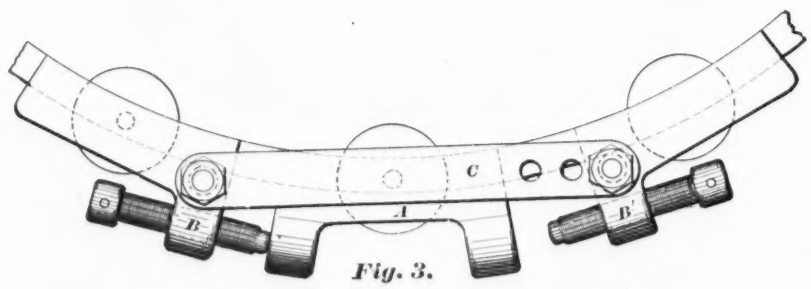


Fig. 3.

Referring to sketch, the arms of index pulley are flush with one side of the rim, hub is bored 1" diameter. Mounted on the lathe for drilling, it appeared something like sketch, Fig. 2. The tall screw cut with square thread just fitted the bore. Double nuts on lower side provided adjustment for bringing the holes being drilled level with lathe centers. The top nut with set screw took up all lost motion, so that it could be revolved in spacing without trouble. The block *D*, Fig. 2, took the place of cross-feed shoe, and was held by bolt passing clear through lathe carriage. In drilling, the carriage was fed by hand against a dead stop, to insure depth of holes being uniform, the tail center, just following up the wheel, was provided with hard-wood center, to avoid marring the face.

Drilling jig, Fig. 4, was carried at the extreme right of the piece *B'*, to which it is fastened by two screws through the slots. The clamping screws had a tendency to keep the pieces away from the rim, and, to counteract this, a slight bevel was turned on that edge of the rim, which made them hug the rim tightly. A. H. LEFEBVRE.

[In a private letter Mr. Lefebvre says he has not said much in this description regarding the degree of accuracy attained by this device, as he does not want to make claims that might seem to be extravagant, but he states, nevertheless, that while the index plates made by well-known makers readily show errors of .001", and gears cut by them are more or less noisy, this index shows no appreciable error, and gears cut by the indexes, after being corrected by this one, run practically without noise. We think that, after looking over his method, few will be disposed to doubt that great accuracy may be attained by it, or that Mr. Lefebvre's statement is at all unreasonable.]

Lathe Construction.

Editor American Machinist:

I have read with considerable interest Mr. Sweet's defense of the swiveling head-stock. If boring taper holes of limited taper is the only purpose for which the lathe is to be used, Mr. Sweet's device is fairly satisfactory. It, however, possesses one fatal defect, in that it is necessary to set the head-stock parallel if the hole is to be reamed. Perhaps a compound rest specially designed would do just as good work, and, as it possesses the advantage of being able to turn any taper, merits careful consideration, at least, before deciding which type of machine is to be built for the purpose of boring taper holes. In ordinary shop practice, however, boring taper holes forms but a small part of the duty required of the engine lathe. It is safe to say that every piece that has a taper hole bored in it has at least an equal amount of other work done on it. Mr. Sweet rarely bores a taper hole that does not have a taper plug fitted to it; for this work his lathe is useless. The only correct and economical way to turn a taper plug is by means of a taper attachment or a compound rest. A taper attachment, when properly designed and well made, is, all things considered, the very best appliance that can be used for boring taper holes or turning taper plugs.

I do not wish to undertake the task of defending all the taper attachments that have been put on the market; but taper attachments are made that entirely eliminate backlash, and have sufficient rigidity to do good work. At the present time I have a 21-inch lathe turning the outside taper of a 20-inch Corliss engine steam bonnet. The bonnet is gripped by the square base and projects about 14 inches from the face of the chuck. The rough cut on the outside is about $\frac{3}{16}$th of an inch deep on a side, and is fed sixteen cuts per inch; the finishing cut is $\frac{1}{4}$ inch wide. The taper attachment operates as steadily and smoothly as if the work were straight and on centers. On about all the taper work that I have to do, and I presume on most of Mr. Sweet's work, there are straight parts, or the ends have to be faced off square. On a lathe provided with a taper attachment, taper and straight work can be done without disarranging the setting for the taper or for the straight part. If Mr. Sweet

wishes to face off an end of the piece in which a taper hole has been bored, he is obliged to set the head-stock parallel; judging from my experience this is not an easy thing to do. Mr. Sweet does not meet the objection raised to this point at all by his remark about the astronomer. An astronomer who can determine the parallax of a star ten thousand million miles away can earn ten thousand dollars a year, yet Mr. Sweet expects a greasy machinist, who is fortunate if he can earn one-tenth of that amount, to set his head stock so that it will bore straight every time. A valuable feature of the taper attachment lies in the ease with which former plates can be fitted to it. It is impossible to make a swiveling head-stock without greatly complicating the feed mechanism, without gaining any compensating advantages therefrom, except the doubtful one of being able to bore taper holes. For proof of this see the drawings of Mr. Sweet's lathe published in the AMERICAN MACHINIST.

Judging from the history of the swiveling head-stock, I do not believe that it is destined to come into general use for boring taper holes. "The survival of the fittest" in this case means the total extinction of the whole race of swiveling head-stocks, and perhaps of bolted head-stocks as well. I have been informed that between thirty and forty years ago lathes fitted with swiveling head stocks were regularly built for the market in New England. The only inference that can be drawn from the almost total disappearance of this class of machine is that it would not do the work for which it was designed as well as other devices. Mr. Sweet's lathe was brought out a number of years ago, and, if the head-stock had been a decided improvement over ordinary practice, it would at least have come into limited use.

C. M. CONRADSON.

Wants Some One to Explain.

Editor American Machinist:

Something came under my notice the other day, and not being able to find a satisfactory cause, I write to your valuable paper hoping to hear from some one who has met with the same difficulty.

I had four pieces of wrought-iron pipe 14″ long, 1¼″ diameter, ⅛″ bore, to turn to 1 3/16″ and ¼″ bore. I fastened one end in a four-jawed chuck and let the other end revolve round the center, so I could true it up to run it in the steady rest. I then commenced to drill it, using an ordinary flat drill ¼″ thick lipped at the cutting edges. I gave it a side bearing of half an inch, and held it in a common drill rest fastened in the tool-post. I ran the work at seventy-six revolutions per minute, and used lard oil. I noticed while drilling that the pipe began to run out, and, by the time I got through, the pipe was curved like a bow, and measured ½″ high in the middle. Two pieces out of the four were as just stated; the third was bowed not quite so much, and the other one was as straight as when I put it in the lathe. They were not all cut from the same piece. The highest temperature generated while drilling was about 150°. I took the precaution to hammer the pieces straight on an anvil before drilling. I think if I had used a turned drill in the form of a rose bit I would have had better results. H. R.

[We believe the trouble was mainly due to unequal strain on the metal of the pipe, brought about in the manufacture.]

Machine Design.

Editor American Machinist:

Mr. Woodward, in his article on machine design, advocates having the head-stock cast on the shears for solidity's sake. He remarks: "Of all the machine work done in the manufacture of other machines, by far the larger part is done in the lathe." For this reason, in my estimation, the casting of the head-stock to the shears is a poor plan.

He also remarks that, "Casting the head-stock and bed in one piece will prevent the common practice of using blocks."

Well, Mr. Woodward, I do not see any special harm in using blocks, as long as the job is got out on time, and satisfactorily. I have known these blocks to save a big percentage of humiliation in not having to refuse a job.

I wonder if F. P. Avery, of whom Prof. John E. Sweet speaks in his article, "The Pleasures of a Machinist," March 6th, 1886, if a job had come to him in his shop, would have refused it because the lathe would not swing it; I guess not.

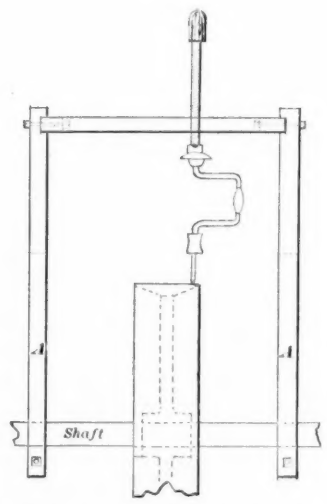
When a man does a job of planing on the drill press, and does it satisfactorily too, he feels satisfied; if he has a lathe with the head-stock cast on, when a job comes in that he cannot handle, he will feel like knocking it off.

I have seen those blocks used to a good purpose in the existence of a struggling machine shop, and I know they are mighty handy. And I have seen the head-stock manipulated for other purposes that would make some one sad, but still the "simon pure" got there.

I would say to those who contemplate buying a lathe, to get one where you can "yank" the head-stock off, for it may save you some humiliation.

There is a great deal in the unexpected, and I think Prof. Sweet has demonstrated the practical utility of the swinging head; but I was very much chagrined in seeing the 16″ lathe, not to see the sleeve system for keeping the screw perfect, for he had made a convert of me there, and I know he will feel bad until he puts one on.

EDWARD D. GLEASON.



Rigging for Drilling Pulleys.

Editor American Machinist:

I send you sketch of rig that I used to drill some pulleys that could not be taken off the shaft. They were drilled to be lagged with wood.

The pieces *A* were slotted to slip over the shaft, and be clamped on the same by bolts shown. The cross-bar had a slot in it the entire length, to allow the feed-screw to slide from one edge of pulley to other, so that I could drill on both edges without moving the rig on the shaft.

The feed-screw was taken from a hand-screw and the end pointed to fit in plate screwed on top of brace. I used an ordinary brace.

With this rig I drilled 126 11/32″ holes ½″ deep in seven hours, including time of moving the rig.

Anent the recent discussion, "Grindstones *vs.* emery wheels," give me the grindstone; I have used both. We are using a 16″ stone at 500 revolutions in our shop, and think it the best we ever saw. We have one side of the stone higher than the other, and put water on the side close to the hub, and allow the centrifugal force to carry it to highest point. JOS. L. GARD.

Reply to Professor Sweet's Criticism.

Editor American Machinist:

Although I consider that the criticism of Professor Sweet upon the lathe bed described in my "Suggestions on Machine Design" is favorable, rather than adverse, there are one or two points to which I wish to call attention.

He tells us that the "greatest strain is up," and in the same breath very ungenerously limits us to two bolts to hold down the cap. From the construction of this particular head-stock, the only strain that can come upon the cap is up, as he says, but the cap is made so that it covers both bearings; and there are, for the 21″ lathe, four ⅞″ bolts at the front and two at the rear bearing, with the nuts set down as hard as it is safe to strain them.

When Professor Sweet says, "About the only lathes I ever built were made that way, . . . I do not wish to be understood as objecting to casting the head stock on the bed, . . . I am persuaded that it is a good thing to have one lathe in the shop with a swinging head," and "If I wanted a lathe with a swinging head to bore tapers, I would make it to swing," he virtually says that casting the head-stock and bed in one piece is much better than to cast them in separate pieces, and in this we agree.

I see no reason whatever for having even one lathe in the shop with a swinging head, if, as all must admit, a solid head is stiffer and better. To my mind, Professor Sweet would spoil a good head-stock to make a poor taper attachment. It is true that many devices for turning tapers are worthless, but it is possible to design one on which can be accomplished, and equally well, *all* that can be done, beside much that it is impossible to do with a swinging head.

D. C. WOODWARD.

Keeping Clippings.

Editor American Machinist:

The AMERICAN MACHINIST has always been an advocate of the keeping of note or memorandum books by progressive engineers and machinists. No better advice could be given. In fact, unless one possesses a phenomenal memory, it is impossible to keep available the latest and best information without resort to a memorandum book. If the book be made up of clippings from periodicals, there is often danger that parts of the article wanted are on opposite sides of the same sheet, or that two desirable articles are so situated as to make it impossible to paste in the clipping without obscuring part of what is wanted. The only escape from this dilemma is by copying the obscured part; but when such part includes an engraving the trouble is insurmountable.

It has occurred to me that if publishers of periodicals would put the advertisements on one side of the sheet and the reading matter on the other, they would thereby confer a great boon on keepers of note-books.

MARINER.

Thick and Thin Boiler Plates.

BY W. H. BOOTH.

Your correspondent "C." qualifies my remarks under above heading in a manner from which I cannot dissent, and at the same time he raises quite an interesting point when he argues that in a high-pressure boiler the water is lighter and the steam heavier than in a low-pressure boiler.

When I referred to foam being a bad quencher, I had prominent in my mind the narrow water spaces of a locomotive boiler, in which I believe many will agree with me the circulation is poor. As "C." remarks, where circulation is really good, the clean foam of boiling water will prove very efficient as a quenching medium, sweeping the surface of a plate of all steam which tends to adhere, and acting, in fact, like so much water. In narrow water spaces, however, up which steam is rising, and to the lower parts of which no free flow of solid cooler water is admitted, there is great danger of overheating. It seems probable that the poor circulation in a boiler, when it is poor, is as likely to be caused by the difficulties in the way of the water getting to the right place to follow the upward movement of steam as in the difficulty experienced by the steam escaping, for it stands to reason that wherever a column of water is changed by heat into water and steam, the gravity of the column is proportionately reduced with the amount of steam intermingled. Given, then, free course for solid water to come beneath such mined column, and circulation must inevitably occur, and the greater the amount of steam the more rapid will be the circulation. I do not, however, quite follow "C." where he says that in a high-pressure boiler, the steam, having a greater density, will therefore better absorb heat than the less dense steam of a low-pressure boiler; for practically in each case the steam when formed is as hot as it can get without super-heating. This of course may occur to some of it, but not to any serious amount, and it would hardly do to count upon this.

Anyhow, it is fortunate that, when most required, the circulation is best with proper constructional details; but when steam forms in such quantity that the circulation cannot, by reason of bad structural design, attain a corresponding velocity, then burning of plates must ensue.

When a plate burns, I believe it is reduced to the sesquioxide upon the water side. We know that, if steam be passed through red-hot iron tubes or filings of iron in a retort, hydrogen is given off by the decomposed steam, the oxygen going to the iron. This process, modified, probably takes place with overheated plates, and is also seen when corrosion takes place beneath scale, the black oxide which can be scraped out of pitted corrosion found under a heavy slab of scale being the same oxide. The reduction upon the fire side will be more evenly distributed over the surface, and due to the formation of a non-hydrated oxide. Indeed, the appearance of a burned plate often reminds one somewhat of blister bar.

Mr. Hill's full half million revolutions per minute sounds high. Is Mr. Hill certain as to the speed of 200 of first wheel? Was this counted or calculated from a belt connection to engine?

I once found that a rotative speed of a light ¼-inch mule spindle of 30,000 per minute took a man's utmost strength to maintain for only ten seconds at that velocity. Experimenters would do well to employ light friction wheels for their bearings, and for very high speeds these again might well run on friction bearings. It would be well that the mechanism should run in vacuo, the main shaft or spindle entering the receiver through a stuffing box. Is there any special utility in securing, even experimentally, a high rate of rotation? Beyond the satisfaction in attaining, say, to a million turns per minute (equal to 4,166 turns in the period of a watch tick) is there any mechanical or physical end to be gained by it?

On the 22d of June there was inaugurated in Bremen an electric tramway one mile in length. The line, which is the first to be carried out in Europe on the Thomson-Houston system, commences at the Town Hall in the center of the town, and terminates just within the entrance to the town park, where an industrial exhibition is at present being held. The generating station is situated near the park, and contains a Pétry-Déreux boiler, a Kirchen engine of 150 indicated horse-power, and a dynamo of 84 electrical horse-power, having a pressure at the terminals of 500 volts. A second dynamo, and an Armington-Sims engine, are also installed, the current from this dynamo being mainly used for lighting purposes. The conductors are carried on insulators fastened to short pieces of steel cable attached to iron masts 20 feet high. They are formed of copper wires 8.25 mm. thick. There are now in regular service from five to six cars, each of which has two motors fixed in a special frame under the car body. On the top of the car is an inclined supporting bar arranged at an angle of 40°. This bar carries a grooved contact roller, which is connected with the motors by a short piece of insulated cable. The contact roller presses against the lower side of the conductor, and around curves suitable leading pieces are arranged so as to keep the rollers on the proper conductor. The cars are fitted with brakes, track clearers and safety appliances. At the depot where the cars are housed there are several pits, which render the motor and gearing readily accessible for inspection, repairs and oiling. The tramway is, with the exception of one narrow street, double throughout.—*London Engineer.*

AMERICAN MACHINIST

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☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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NEW YORK, SEPTEMBER 25, 1890.

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Use of Opportunities.

Young men generally enter a profession or trade with bright visions of future prosperity, and, after the apprenticeship has been served, look forward to opportunities which will start them on the road to positions of honor and affluence. Yet many seem to forget that it is not so much the opportunities as the use made of them that tells in the end. And these opportunities present themselves in many cases as soon as a young man enters the profession. Good, honest toil during the allotted working hours in a shop gives a person a reputation for being faithful and industrious, but it by no means follows that this alone, however necessary it may be, will lead to promotion. A man must also work with intelligence, and for this he needs an education, which, when a college course is out of the question, can only be obtained by study during leisure hours. Recreation after working hours is necessary, but to devote every evening during the week to pleasure is a neglect of the use of opportunities which is sure to be felt in after years, and will often blight the hopes of ambitious minds. Constant work without intelligence may become a burden, but intelligence will often turn work into a pleasure.

We have heard of an engine builder who, when asked how much lap he gave to a valve, had to admit that he did not know what lap meant, and when asked how he managed to design his engines, acknowledged that he copied other good patterns. Now it may be a satisfaction to this builder to turn out good work and lots of it; but is it honest to quietly copy other builders' designs, which may have been perfected only by a considerable expenditure of time and money? Would not this builder have derived a greater satisfaction, and in fact a pleasure, from his daily labors, if he had been able to design his own engines? We certainly think he would.

The proper use of opportunities—and many will present themselves in the beginning of a profession—will certainly bring a reward in later years. If, therefore, honest ambition is to have its sway, study in leisure hours is absolutely necessary. The time may come when the ambitious man will be called upon to make his own designs, and then a practical experience, combined with a theoretical knowledge, will be of great benefit. It is true that some details of a machine can only be perfected by a tentative process, and here good common sense and practical experience will be of avail; but it is also true that many details of a machine can be at once correctly proportioned by computation, and thereby expense and time saved, and vexatious and annoying delays or failures avoided. Success cannot be gauged by accumulated wealth alone; a man must also possess self respect, and be able to command the respect of others.

Greater Safety Wanted.

As we noticed a few weeks since, the crop of railroad accidents this summer, and so far this fall, is a large one. Its proportions ought to provoke inquiry as to whether it is not time the methods of railroading so largely in vogue in this country were reformed. If the value of a human life is just five thousand dollars then there may be gain in cheap railroading. It might be, financially, the proper thing to operate with insufficient and cheap help, keep the road and stock in a low condition, and pay the cost of killing people. But the people are interested beyond the question of dollars and cents. Such kind of wholesale recklessness has a bad moral effect on the whole country, and the knowledge that this is so will bring about laws compelling reforms in railroading here just as it has done in older countries.

It is urged, with a great deal of truth, that the cheap methods of building and operating railroads in the United States is a large factor in the development of the country. But this is a thing that can be carried too far. Better have fewer and better railroads, even at a higher cost for transportation. What is wanted now is greater safety. Greater safety not only for travelers, but for those who handle the trains. This can only be had by the adoption of better methods, and the public will have it to pay for. For, as previously intimated, notwithstanding the smash-ups cost the railroad companies a good deal of money, the most improved methods of operating railroads would doubtless cost them more. But the public is willing to pay something for the luxury of safety.

The discovery has been made, almost by accident, that one of the great English battle ships is in a dangerous condition, so far as her shaft and stern fittings are concerned. It is believed that, had she gone to sea in the condition in which she was found, a breakdown, with serious consequences, would have resulted. It appears that the shaft got badly out of line with the usual disturbing consequences. Whether or not the case is as bad as reported, it serves again to call attention to the particularly weak point in modern steamships; that is, that a part of the shaft is out of sight, that wear is likely to occur at that part with unusual rapidity, and the inevitable getting out of line begins the operation of breaking the shaft at the point least able to stand the strain.

There is room for invention here—something that will permit one part of the shaft to go down in its bearings without bringing into play such enormous breaking strain. It is a difficult problem, and may never be solved—the making of a coupling through which such great power can be safely transmitted, and which will answer the other requirements. But it is something worth giving attention to.

English capitalists continue to invest their money lavishly in this country in various large enterprises. We do not believe this is particularly good for the country. Of course they put their money into business for the profits they can make, and what they make will be mainly spent at home. But aside from any question of this kind there is a question of reason. That is, why are English capitalists willing to invest their money here, buying out established works, and paying a good round price? The conclusion seems inevitable that it is because they are satisfied with smaller returns than Americans. When an American capitalist invests his money in business he expects to "make a million" in ten years. The Englishman is satisfied with moderate and reasonably sure returns. It would be better for the country if Americans were more inclined to the same way of thinking. It would give an actual permanency to affairs that is sometimes lacking here. If our English friends can make satisfactory profit in great enterprises here, then American capitalists will have to be content with about the same profit.

Two cities in the South have followed the example set by Philadelphia and Richmond in assuming the work of lighting the streets by electricity, and now it is proposed to go a step farther and supply light to the people, just as water is supplied. An English city was the first to do this, and in England other cities are following the example, and really it is the proper way. Such necessities as water and light should be supplied by public plants wherever possible. Gas, water and electric light plants ought to be a part of the public service, and not the property of private parties.

The foregoing is from the *Jersey City Journal*, a paper noted for its ultra-conservatism. It goes its distance in the way of showing that public opinion is crowding in the direction of permitting the people to supply themselves with some of the necessities of life; in not forcing them to pay tribute, two or three times over, to corporations, for the privilege of living on the earth we inhabit.

Business prospects in the machinery trades look encouraging for the fall. A good many manufacturers are considerably behind their orders, and all, so far as we know, are doing well. There seems to be a healthy demand for machinery, that bids fair to grow better. The steam engine trade is good, the machine tool business is good, and business is good in general lines of the machinery trade. New enterprises that call for machinery are being launched with great frequency, and the demand seems fully equal to the supply. In general lines of business the prospects appear to us to look more favorable than they did one month ago. The Wall street flurry has had but little effect, and the shortage in crops is by no means so great as was anticipated; on the whole, the outlook seems to be more than fairly bright.

Literary Notes.

American Shipbuilder is the name of a new paper published by Bradley & Howell, at 115 Broad street, New York. It starts out with good prospects of success, and will undoubtedly find a field in the shipping interests of the country, to which it is devoted. We wish it all luck.

We have received from Edward C. Baldwin, secretary of the Young Men's Institute of the Young Men's Christian Association of New York, 222–224 Bowery, the prospectus for 1890–91. There are many attractions, amusing and instructing, in the building of the association, which can be enjoyed for a nominal sum. A committee is in waiting each evening for the purpose of showing young men through the building. Entertainments and lectures by prominent specialists occur at intervals. There are evening classes embracing subjects: Commercial; mechanical; language; musical and physical. The class in steam engineering, in which many of our readers should be interested, will be under the instruction of Wm. H. Weightman, who has filled the position for two years. The class in free hand drawing will be taught by George W. Breck, and that in mechanical drawing by Edmund J. Maurer. The classes begin their sessions Wednesday, October 1.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(378) C. K., Philadelphia, Pa., writes: Please inform me how to make prints, blue lines on white ground, and black lines on white ground. *A.*—See our issue of September 4, page 3, current volume; and also our issue of January 22, page 4, 1887.

(379) W. A. V., Halifax, N. S., asks: What is the rule for finding the diameters of cylinders for a compound engine? *A.*—See answer to Question 6 in our issue of January 2, current volume. 2. What would be the best valve motion for a compound engine? *A.*—That will depend on the purpose for which the engine is to be used, and also on the size and type of engine. Good judgment and experience are necessary in designing the valve motion.

(380) A. F. W., Newcomerstown, O., asks us to describe the best method of balancing long rollers, pulleys or cylinders, in running balance. *A.*—In our issues of February 10 and May 19, 1883, and many subsequent issues, articles will be found which show the difficulty of devising methods for obtaining a running balance of pulleys, etc. Illustrations of the different methods used and proposed are also given in these articles. On the whole, we believe that the best method to pursue will be to adopt one of the machines made for this purpose by the Defiance Machine Co., of Defiance, Ohio.

(381) Locomotive, Waterville, Me., asks: What is the fastest time on record made by a locomotive? *A.*—Perfect records of locomotive speeds are not kept, hence it is difficult to answer your question with reasonable confidence. If our memory is not at fault, 86 miles per hour have been made for a short distance. 2. Where is the largest locomotive? *A.*—The largest locomotive is used in the mountain service of the Union Pacific road. This engine and the others of its class are the heaviest in regular freight service. It has eight coupled wheels, and a two-wheeled swing bolster truck. Gauge, 4 feet 8½ inches; cylinders, 22 inches diameter, and 28 inches stroke; driving wheels, 4 feet 8 inches diameter; fuel, soft coal; rigid wheel base, 14 feet, total wheel base of

engine, 22 feet 3 inches; total wheel base of engine and tender, 49 feet ¼ inch; length of engine and tender over all, 62 feet 7¾ inches; weight on drivers, two gauges of water, about 138,000 pounds; weight of engine, two gauges of water, 153,000 pounds. Heating surface of fire-box, 178 square feet; heating surface of tubes, 2,144 square feet; total heating surface, 2,322 square feet; and area of tube openings, 833 square inches. 3. Why do European locomotives have such small cabs? *A.*—There is no reason for the use of the small cabs. 5. What is a pony truck? *A.*—A two-wheeled truck. 6. Can you tell me of a good book for young firemen? *A.*—Locomotive Engine Running and Management, by Angus Sinclair.

(382) O. M., San Francisco, Cal., writes: Please give me the rules for getting the diameter of the shaft and area of the valves for a walking beam condensing engine, steam pressure from 35 to 50 pounds per square inch. *A.*—For finding the diameter of a wrought-iron shaft, the following empirical rule may be used. Multiply the indicated horse-power by 129; divide the product by the number of revolutions per minute, and extract the cube root from the quotient; the result will be the largest diameter of the shaft in inches. The largest diameter of the shaft in this class of engines is near the inside of the paddle-wheel. A symbolic expression of this rule is,

$$d = \sqrt[3]{\frac{H \times 129}{R}}$$

in which d denotes the diameter of the shaft in inches; H. the indicated horse-power; and R, the number of revolutions per minute. This rule will answer only for comparatively large engines with one cylinder, say from 500 horse-power and upwards. To find the area of the valves, multiply the piston speed in feet per minute by 0 1, and divide the product by 600, and multiply this quotient by the area of the piston in square inches; this last product will be the total clear area of both openings of the valve. Since one of the disks of this valve must be larger than the other, so that the poppet valve can be placed in position, a little more than one-half the area found by the rule must be given to one opening, and the remainder for the opening of the other valve.

(383) D. F., Buffalo, N. Y., writes: I wrote you some time ago about certain proportions, etc., of a traction engine I proposed building, which you answered through the columns of your valuable paper very satisfactorily. I find, after using the engine, I should have more power from it. The engine has a single cylinder 9″ diameter. 12″ stroke; number of revolutions, 250 per minute; steam pipe, 2½″ diameter; exhaust pipe, 3″ diameter; steam ports, 8½″x⅝″; valve travel, 3″. How many horse-power would I gain by substituting a cylinder 10″ diameter, making the steam ports 9½″ long, ¾″ wide, and leaving the connections as before, also leaving the revolutions and speed of the engine on the road the same? Or would you advise leaving the cylinder as it is and speed the piston to, say, 600 feet per minute, and changing the gearing to suit, that is, to have the engine travel on the road same speed, with 600 feet of piston travel, as it did with 500 feet? How many horse-power will I gain by it? By using the 10″ cylinder I feel my connections, or some of them at least, are not strong enough (although they have shown no signs of weakness), as I was confined by weight. I found the boiler was ample and supplied steam very easily, using very common fuel. I used as high as 120 pounds boiler pressure, getting about 60 indicated horse-power with 250 revolutions per minute. The engine made 2½ miles per hour. *A.*—With a mean effective steam pressure of 60 pounds per square inch, the engine in her present state will develop 57 indicated horse-power. With a cylinder 10″ diameter, and with the same mean effective pressure, everything else being left as before, the engine will develop 71 indicated horse-power. With the 9″ cylinder, and the piston speed increased to 600 feet per minute, the engine will develop 69 indicated horse-power. We should simply increase the piston speed to 600 feet per minute, and not change the size of cylinder.

(384) N. E., Allegheny, Pa., writes: Please inform me at what speed it is safe to run a fly-wheel. I suppose the thicker the rim the safer it is to run the fly-wheel. If there is any way of computing the speed, please give rule. *A.*—Let T denote the tensile strength of cast-iron per square foot of area; v, the mean velocity of the rim in feet per second, that is to say, the velocity of a point situated midway between the inner and outer circumference of the rim; W, the weight of a cubic foot of cast-iron; and g, the acceleration due to the force of gravity, which may be taken at 32.2 feet per second. Then for computing the speed we have the following formula:

$$v = \sqrt{\frac{gT}{W}}.$$

Which reads: The mean velocity in feet per second is equal to the square root of the quotient obtained by dividing the product of the acceleration due to gravity into the tensile strength per square foot of the iron, by the weight per cubic foot of the iron. If, for example, we assume $T = 259{,}200$ pounds per square foot, and the weight $W = 450$ pounds, and then substituting in the formula for the symbols, their values we have

$$v = \sqrt{\frac{32.2 \times 259{,}200}{450}} = 430.7 \text{ feet per second,}$$

which is the speed at which the fly-wheel will burst. If we use a factor of safety of 10, we have

$$v = \sqrt{\frac{32.2 \times 259{,}200}{450}} = 136.2$$

feet per second for a safe speed. In practice, the rim of fly-wheels is in some cases pushed to about 80 feet per second, but this speed is seldom exceeded. It must be noticed that, in these computations, we have neglected the support which the rim receives from its arms. It will also be noticed that the thickness of the rim does not enter into the calculation, and the reason for neglecting it is, that it will not affect the speed; or, in other words, an increase of thickness will not permit an increase of speed, because increasing the thickness will also increase the centrifugal force, which tends to burst the fly-wheel.

(385) Reader, Chicago, Ill., writes: Kindly inform me how the diameters of piston rods and eccentric rods are computed. *A.*—Piston rods for nearly all kinds of steam engines are subjected alternately to a tensile and compressive stress. In calculating the strength of any piston rod the tensile and also the compressive stress to which it is subjected must be considered. We first find the diameter which will give the piston rod sufficient strength to resist the tensile stress; then we find the diameter which will give the piston rod sufficient strength to resist the compression. The larger of the two diameters must be adopted. In computing the strength to resist compression, the rod is assumed to be a pillar with one end flat and the other rounded, namely, flat at the piston, and rounded at the crosshead, and then follow the rules established for finding the diameter of such a pillar. But generally, for ordinary stationary engines, the piston rod is strong enough if its cross sectional area is such that the stress will not exceed 5,000 pounds per square inch. Hence we have the following rule: Multiply the area in square inches of the piston by the steam pressure per square inch; the product will be the total stress on the piston rod. Divide this product by 5,000; the quotient will be the area in square inches of the cross-section of the piston rod; the corresponding diameter of this area and an addition of ⅛th of an inch for wear to this diameter will be the required diameter. The foregoing rule is for wrought-iron piston rods; steel rods should have an area equal to .8 of the area found by the foregoing rule. For finding the diameter of the eccentric rod we have the following formula: Let L and B denote the length and breadth in inches, respectively, of the back of the slide valve; and p the steam pressure per square inch on the valve; we have then for the area of section of eccentric rod at small end $= 0.00006\ p\ B\ L$ square inches; and for the area of the eccentric rod at large end $= 0.00008\ p\ B\ L$ square inches. 2. What is the function of a receiver in a compound engine? *A.*—When the pistons in a compound engine do not move simultaneously in the same direction, for instance, if they move as in a compound engine in which the cranks are set at right angles to each other, a receiver is required to hold the steam exhausted from the high pressure cylinder until the low-pressure cylinder is ready to use it. In short, the function of a receiver is what its name implies; it receives the steam from one cylinder, and holds it until the other cylinder makes a demand upon it. 3. Give rule for the weight of a fly-wheel. *A.*—See answer to Question 466, in our issue of December 19, 1889.

(386) J. T. T., Dayton, O., writes: Kindly inform me what data in connection with a boiler is it necessary to have to compute the number of pounds of water it will evaporate? *A.*—In ordinary boiler tests the object is to find the quantity of water evaporated per pound of coal, and the quantity the boiler is capable of evaporating. Several plans of procedure, with various modifications, are employed, each of which has its advocates. One is to raise steam to working pressure, then draw the fire, and build a new one, weighing and charging up all wood and coal used to the termination of the test. To reduce the wood to its equivalent in coal, multiply the pounds of wood used by 0.4. Thus, if 50 pounds of wood are used in starting the new fire, the equivalent in coal will be $50 \times 0.4 = 20$ pounds. At starting the fire, the water level and steam pressure should be accurately noted, and these should be exactly the same at end of the test; they should also, as far as practicable, be kept constant during the entire trial. The test should last at least ten hours of continuous running, without stopping for meal times. In some tests the steam is allowed to escape into the atmosphere as fast as it is generated; in others, it is used for running the engine. If the boiler is connected to same steam pipe with other boilers, an extra outlet for steam with valve in the same should be provided, so that in case the pressure should rise to that at which the safety valve is set, it may be reduced to the desired point by opening the extra outlet without checking the fires. If the boiler is connected to a main steam pipe with other boilers, the safety valve on the boiler being tested should be set a few pounds higher than those of the other boilers, so that, in case of a rise in pressure, the other boilers may blow off, and the pressure be reduced by closing their dampers, allowing the damper of the boiler being tested to remain open, and firing as usual. The time of cleaning the fires will depend upon the character of the fuel, the rapidity of the combustion, and the kind of grates. When very good coal is used, and the combustion not too rapid, a ten-hour test may be run without any cleaning of the grates, other than just before the beginning and just before the end of the test. The coal should be weighed, and delivered to the firemen in equal portions, each sufficient for about an hour's run, and a fresh portion should not be delivered until the previous one has all been fired. The amount of water fed into the boiler should be accurately determined by weighing it, or measuring it in a tank of known capacity. Water meters as a rule, if used, should only be used as a check on other measurements. The amount of water used, the average pressure of steam, and the temperature of feed-water during the time of trial, should be carefully recorded. Immediately at the conclusion of the test the fire should be drawn and quenched, and the unconsumed coal picked out, weighed, and deducted from that charged as being used. If it is desired to find the combustible used, everything that comes from the fire during and at the conclusion of the test should be weighed and deducted. The coal (and the equivalent in coal for the wood) supplied to the furnace, including that used in starting the fire, less the unconsumed coal, weighed back, is the amount charged to the test. The amount of water evaporated is a measure of the capacity of the boiler, and this amount divided by the amount of coal used gives the number of pounds of water evaporated per pound of coal, and shows the economy. It is customary to state the economy of the boiler in equivalent evaporation from and at 212° Fah. For an accurate test many other precautions are necessary, and for these we must refer you to the Handbook of Engine and Boiler Trials by R. H. Thurston, M. A., LL. D.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Friday morning for the ensuing week's issue.

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Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Sept. 11, p. 18. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

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For Sale—Bound volumes of the Patent Office Gazette for years 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by F. W. Barber. 1,936 illustrations, 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

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"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES

J. F. Byers is building a machine shop at Ravenna, Ohio.

J. A. George, Rome, Ga., will erect a foundry and machine shop.

The Tampa Ice Co. will probably rebuild its ice factory at Tampa, Fla.

The Kingsbury Manufacturing Co., of Florida, is erecting a machine shop.

A boiler and engine works will, it is stated, be established at Luray, Va.

John Bayer & Son will erect a 25 or 40-ton ice factory at Charleston, S. C.

The Diamond Slate Iron Co., at Wilmington, Del., are building a new foundry.

A cotton-mill will be put up by a newly formed company at Wadesboro, N. C.

A sash, door and blind factory is reported as being erected at Shendun, Va.

The roller-mills, which were burned down at Belton, Texas, will be rebuilt at once.

J. W. Garratt & Co., St. Louis, Mo., are contemplating an addition to their foundry.

The Batesville Iron Works, Batesville, Ala., will add a foundry to its machine shops.

An effort is to be made to start a woolen-mill at Tyler, Texas, with a capital of $20,000.

Ground has been broken for the new buildings of the Ironton Steel Co. at Duluth, Minn.

The cotton factory at Arkadelphia, Ala., has received $10,000 worth of new machinery.

A $10,000 stock company is being organized to erect a furniture factory at Buena Vista, Va.

The Keystone Machine Co., of Williamsport, Pa., will move its machine works to Goshen, Va.

The Tiffany Iron Works, at Tecumseh, Mich., has been incorporated, with a capital of $50,000.

W. A. Spargar is reported as putting new machinery in his cotton factory at Bristol, Tenn.

The Selma (Ala.) Electric Light and Gas Company will, it is thought, put in an incandescent plant.

It is believed that the Camden & Alexandria Railroad Co. will erect a planing mill at Camden, Ark.

A Richmond (Va.) syndicate is negotiating for the erection of a $200,000 tobacco factory in Oxford, N. C.

Jacob Peye is organizing a stock company to enlarge and operate the Chattanooga (Tenn.) Cotton mills.

Mr. Faust, of Mahanoy City, Pa., will, it is thought, move his wood-working factory to Newcastle, Va.

It is stated that a Canada steel manufacturer will remove his plant to Atlanta, Ga. J. M. Brosius is interested.

A. E. Rice and others, Chicago, Ill., have incorporated the Rice Machinery Co., to manufacture machinery.

J. F. Byers, manufacturer of the Byers hoisting engine, is building a machine shop and foundry, at Ravenna, O.

It is said that extensive works will be erected on the property of the San Francisco (Cal.) Gas Lighting Company.

The Bluffton Car Wheel Co. is the name of the stock company organized to build car-wheel works at Bluffton, Ala.

The Greenville Ice and Storage Co. has been organized, and will erect a 10-ton ice machine, at Greenville, Ala.

It is said the American Fire-proof Steel Car Company will locate in the town of Bloom, Ill , near the Indiana line.

The De Leach Manufacturing Co., of Atlanta, Ga., are putting up a new foundry and machine shop, 400x70 feet.

The Greenwood Land Co. is reported as to establish a $50,000 sash, blind and door factory, at Bedford City, Va.

Phosphate works, to cost about $42,000, will probably be erected at Fernandina, Fla. Mr. Bushnell can give information.

The new town of Kensington, Ga., is going to have a 20 000-spindle cotton-mill for sure, and an other cotton-mill, perhaps.

It is proposed to establish an electric light plant at Santa Fe, N. M., at an estimated cost of $25,000. C. F. A. Fischer is interested.

The Georgia Southern & Florida Railroad Co. will erect machine shops at Macon, Ga., to accommodate 1,000 miles of railroad.

The Commercial Electric Light and Power Company has been incorporated at Tacoma, Wash., with a capital stock of $250,000.

The Frackville and Gilberton Light, Heat and Power Company has been incorporated at Frackville, Pa. Capital stock, $40,000.

Overman & Schrader will erect a tarring house at their twine factory, Covington, Ky., and put in $50,000 worth of new machinery.

The Sheffield Boiler, Foundry and Iron Works at Sheffield, Ala., has let the contract for the erection of five buildings of iron and brick.

It is probable that an electric light plant will be established at once at Howell, Mich., by the Howell Electric Light and Power Company.

Louis Reubin and S. W. Harland, of Louisville, Ky., and others have purchased the Gallatin Cotton-mill at Gallatin, Tenn., for $20,100.

A scheme is afoot for putting up a large cotton-mill at Jackson, Miss., and for operating it with a capital of a quarter of a million dollars.

The Beaver Tube Company., Wheeling, W. Va., chartered with $1,000,000 capital stock, will build a new town and a large plant near Lewisburg.

The North Chattanooga Manufacturing Co. will, it is reported, erect works for the manufacture of mill machinery in North Chattanooga, Tenn.

The Cummings Iron Works, at Hammond, Ind., have been purchased by a syndicate, who, it is said, will increase the plant, and employ 500 hands.

A company has been formed at Parkersburg, W. Va., for the purpose of making the Hastings steel wire nail, also for building the machines.

A cotton-mill with capital of half a million dollars is talked about at Appleton, Wis. Mr. H. J. Rogers is one of the movers in the enterprise.

An Indiana firm will, it is stated, establish a factory in Dallas, Texas, for the manufacture of boxes, egg cases, etc. Leo Wolfson is interested.

The Buena Vista Manufacturing Co. will, it is reported, erect an ice factory, and contemplates the erection of a fertilizer factory at Buena Vista, Ga.

It is rumored that the Farmers' Alliance will organize a stock company for the purpose of erecting a rice-mill, grist-mill and cotton gin at Callahan, Fla.

The Suburban Electric Co. has been incorporated at Philadelphia, Pa., with a capital of $200,000. The directors are T. W. South, H. A. Mullin and others.

D. Williams & Co., of Gordon, Ala., will, it is stated, put in new machinery for the purpose of manufacturing barrel headings, staves, laths and shingles.

The Spalding Iron Works at Brilliant, Ohio, were sold at sheriff's sale, Sept 2, to George K. Wheat, of Wheeling, W. Va., for $6),000. The furnace will be st rted up.

The contract has been signed for the removal of a car manufacturing plant, which gives employment to 300 people, from Williamsport, Pa., to Goshen, Va.

The boiler works of Rarig & Nichols, at Columbus, O., will be removed to Buena Vista, Va. It is expected that the new plant will be in operation by January 1.

It is stated that a Northern company will establish a $400,000 hardware manufacturing plant in Luray, Va. The Valley Land and Improvement Co. are interested.

Work is being pushed on the new extension to the Langley Mills, Langley, S. C. It is proposed by President Barrett to have the work finished by the 6th of October.

The American Copper, Brass and Iron Works is the style of a new Chicago corporation with $25,000 capital stock. They will manufacture brewery and distillery apparatus.

E. W. Taylor, S. D. Rainey, L. A. Pires and others have incorporated the Greenville Compress and Manufacturing Co., Greenville, Texas, with a capital stock of $500,000.

The electric lighting plant at Middletown, Del., is to undergo extensive improvements. Among the improvements is included a new engine, also new boilers and dynamos.

The Buena Vista Engine and Boiler Works has been organized at Buena Vista, Va., with A. K. Rarig, president; A. T. Barclay, vice president, and J. H. Millen, secretary.

The legislature will, it is reported, be petitioned for authority to issue bonds for the construction of water-works and the erection of an electric light plan at Buena Vista, Ga.

The Birmingham (Ala.) Agricultural Works will, it is reported, enlarge its plow works, and put in new machinery for the manufacture of all kinds of agricultural implements.

Greenville, Texas, is to have an electric light plant, a furniture factory is just completed, and a foundry and machine shop are among the enterprises that are to settle there.

The Pittsburgh Bridge Co. of Pittsburgh, Pa., has received the contract for building a new iron and steel bridge across the Sandy River near Phillips, Me. The contract price is $40,000.

The Giant Key-Seater Company, East Saginaw, Mich., recently shipped a No. 1 key seater with rack-cutting attachment to Blackburn, Attenborough & Sons, Nottingham, England.

C. R. King, W. T. Besonette, W. C. Smith and others have organized the Atlanta (Ga) Novelty Manufacturing Co., to manufacture wood and metal novelties. The capital stock is $300,000.

Work has begun on the construction of the steel plant at Tredegar, Ala. The plant is to include a steel-mill, rolling-mill, rail-mill and cotton-tie-mill, and will have a daily capacity of 300 tons.

M. M. Rogers, L. L. Powell, W. S. Gooch and others will, it is reported, organize a stock company to erect a plant at Roanoke, Va., for the manufacture of the Woolly patent electric motor.

There is talk of organizing a co-operative association with a capital stock of $500,000, for the purpose of erecting cotton and woolen-mills, furniture factories, etc., at Vicksburg, Miss.

During August, the Allegheny Bessemer Steel Works, of Duquesne, Pa., manufactured 16,814 tons of rails, 20,000 tons of raw steel, and 17,000 tons of blooms, which is the largest run in its history.

A stock company has been incorporated by W. E. Jackson, R. A. Springs, of New York, Asbury Hull and others to establish a cotton-stalk bagging factory, at Augusta, Ga. The capital stock is $500,000.

The People's Light, Heat and Power Co. has let the contract to G. B. Shaw, of Eau Claire, Wis., and L. N. Cox, of Washington, D. C., for the erection of a $40,000 electric light plant at Asheville, N. C.

The Lee Smoke Burner and Fuel-saving Furnace Company, of Chicago, Ill., has been incorporated, to manufacture smoke-burning apparatus. Incorporators, D. Lee, Charles O. Barnes and G. P. Merrick.

It is said that contracts have been signed for the erection of a rolling-mill, iron furnace, foundry and machine shops, and other industries at Kensington, Ga. Negotiations are also said to be pending for pipe works.

The Collins Automatic Car Coupler Company has been organized at Farmville, Va., with W. G. Dunnington, president, and J. R. Martin, secretary, for the purpose of manufacturing the Collins automatic car coupler.

The Central Woolen Company's new brick-mill at Stafford Springs, Conn., is now completed, and will be fitted at once with the best modern machinery, which will increase the capacity of this company's mills to 7 sets.

The Lawrence Iron and Steel Company, of Ironton, Ohio, will soon commence the removal of its plant to Glasgow, Va. When the removal is complete some extensive improvements and additions will be made to the plant.

The Salem Machine and Car Company, at Salem, Va., has been organized with the following officers: J. W. M. Allernong, of Salem, president; L. V. Stinson, of Concord, N. H., vice-president; and E. S. Strayer, of Salem, treasurer and secretary.

A license of incorporation has been granted to the J. W. Day Hardware Manufacturing Company, at Chicago, to manufacture and sell hardware novelties; capital stock, $10,000; incorporators, Charles E. Gorton, Harry Harrison and others.

The foundation has been completed for the building of the Steel Truss Car Wheel Works, Edwardsville, Ill. The contract provides that the entire structure shall be completed by November 1. Part of the machinery for the plant has already arrived.

The Builders' Supply and Manufacturing Co. has it is stated, purchased the sash, door and blind factory, dry-kilns, etc., of Messrs. Harvey & Hilliar, at Pensacola, Fla., and will operate same, and probably put in machinery for the manufacture of furniture.

The track bolt works of the Springfield Iron Co., Springfield, Ill., which were destroyed by fire July 12, have just been started up again. The entire plant has been thoroughly remodeled, and the facilities for turning out first-class work are greatly improved.

D. Lowenburg, I. E. Campe, H. Nixdorf and others have incorporated the Norfolk Manufacturing Co., with a capital stock of not less than $20,000 nor more than $50,000 for the purpose of manufacturing cotton, woolen, silk goods, etc., at Norfolk, Va.

A charter has been granted in Halifax County, N. C., to the Great Falls Water-power Manufacturing and Improvement Company, which has for its principal object the development and utilization of the water-power of the Roanoke River between Weldon and Gaston.

A new industry, to be known as the Nashua Lock and Hardware Company, has begun operations at Nashua, N. H. The organization has just been completed, and is capitalized at $20,000. Work will be begun in the vacant building of the Nashua Lock Company.

The Georgia Manufacturing Company, of Whitehall, Ga., running 5,120 spindles and 120 looms on sheetings and drills, is putting in new preparatory machinery from the Kitson Machine Works, of Lowell, Mass., and is also intending to replace some of its looms with new ones.

The Lancaster Steel Roofing Co. has decided to move its plant from Lancaster, O., to Duluth, Minn. The company now employs 25 men, but it is said the force will be increased to 100 men on its removal there. Roofing plates eight feet long and two feet wide are manufactured by this company.

The buildings of the Hercules Iron Works at Aurora, Ill., are finished. The company will soon have the machinery in place. The buildings are composed of brick and stone, and comprise a machine shop, foundry and office. The products of these works are steam engines, ice machines, etc.

The Cleveland Twist Drill Company, Cleveland, Ohio, write us that their business for the past summer has been much greater than was anticipated, and beyond the capacity of the works. This has induced an increase of 75 per cent. in the turning department and large additions to the factory, enabling the filling of orders promptly.

Pedrick & Ayer, Philadelphia, Pa., send a "pocket edition" price list that is excellent in every respect. Although only about three by four and one-half inches, it contains cuts of their milling machine and attachments, open-side planers, special tools, and their general line of machinery for railway repair shops, and for other purposes.

The Lowell Machine Shop, Lowell, Mass , is fitting out a new cotton-mill in Brazil, and it is also equipping a factory in Georgia for the manufacture of cotton bagging. The company is now running its works full time, with orders enough to keep it busy for a good while to come. It is getting a full share of the work in the new mills going up in the South.

A new machine shop is to be erected by the Dwight Cotton Manufacturing Company, Chicopee, Mass., which will also be used as a wood shop. It will be located back of mill No. 5. The building will be 210x40 feet, two stories high. New iron-working tools will be put into the lower room, in addition to the machines now in the company's machine shop.

Large boiler works, rolling-mills and tube works are being erected at New Portage, O., to be operated by a syndicate or stock company known as the Sterling Manufacturing Company, with O. C, Barbour, of New York, president; Allen M. Sterling, secretary and treasurer, and Thomas J. Deegan, of James P. Witherow & Co., general manager. The organization has a paid-in capital of $500,000.

The Gates Iron Works, of Chicago, Ill., are making extensive improvements in their plant. On the lot adjoining the old works on the south they have built a large shop, 64x150 feet. There are three traveling cranes, each running the full length of the building. The center crane is 22 feet high, and those on the sides are each 19 feet. The center trolley is intended to handle the heaviest machines built by the company, weighing from 40,000 to 80,000 pounds each.

The Berlin Iron Bridge Co., East Berlin, Conn., send us a very interesting catalogue illustrating work done by the company. The illustrations are of machine shops, foundries, electric light stations, blacksmith shops, water-works stations, ship sheds, arcades, doors, and a variety of other structural work; also bridges and structural iron. The illustrations are very instructive as showing the variety of purposes to which structural iron is put by this company. Descriptions accompany the engravings, making the catalogue a very complete one for reference.

The Sharon Iron Company, of Sharon, Pa., has been incorporated under the name of the Sharon Iron Company, Limited. The capital stock of the company is $1,000,000, divided into 10,000 shares of $100 each. C. H. Buhl, of Detroit, is chairman of the concern; Mr. Frank Buhl, of Sharon, is the treasurer; and Mr. David Adams secretary. The company has over 700 men on its pay roll at present, and is running in every department of its works. The change to a stock company was made to facilitate the transaction of business.

The president has appointed a board of army officers to inquire into the facilities for producing steel forgings for high power guns at or near the Pacific coast, and in the vicinity of the Rock Island Arsenal, and in the vicinity of the Indianapolis Arsenal, and at some point on or near the Gulf coast; and the advisability of erecting gun factories for finishing and assembling high power guns to be mounted in fortifications, at the Benicia Arsenal, in California, or at the Rock Island Arsenal, or at some point on or near the Gulf coast which may be found most convenient for the purpose. The board is also to examine and report as to the capacity, cost of erection and equipment of each of such gun factories.

At a special meeting of the directors of the Globe Yarn Mills, Fall River, Mass., on Tuesday of last week, it was voted to build an addition to No. 2 mill this fall, and to increase the spindles by 15,000. The necessary plans for the same are being prepared, and operations will be commenced at once and machinery ordered. The addition to the building will be about 200x50 feet, three stories high, and it will be constructed of brick. This addition will make the Globe Yarn Mills the largest plant, solely for spinning yarns, in the country, and bring its total capacity up to about 100,000 spindles and 19 000 twisters. The increase is made because of the constantly increasing demand for its products.—*Boston Journal of Commerce.*

The English electric welding syndicate has just placed an order with the Thomson Electric Welding Company, of Boston, Mass., for 16 welding plants for various classes of work from wire to 2-inch shafting. Each plant, says the Boston *Herald*, is to be complete in itself, and ready to be placed with different manufacturers in England, who are waiting for them. It is the intention of the English company to establish works of its own near London, but until this can be done the American company will assist in every way possible. A contract for the mutual interest and protection of both companies has been executed, which will bring the companies into close relationship in the future. The English company is to be brought out probably in November.

Negotiations are said to be in progress and practically completed, by which the entire steel plant of the Harper-Swift Company, located in one of the suburbs of Cincinnati, will be transferred to Duluth, Minn. In Cincinnati the plant occupies fifteen acres of space, and twenty acres have been set apart for it in close proximity to West Duluth. One thousand men will be required for day work and 500 for the night shift. The cost of the entire plant will be $1,000,000. The proprietors of the enterprise are Messrs Joseph Selwood, E. L. Emery, E. C. Gridley, F. C. Bowman, A. M. Stearns, M. Douglas, of Duluth, and W. C. Stearns, of Chicago. The company controlling the steel plant will be entirely reorganized, with new men and larger capital. The principal business of the company will be the manufacture of structural steel and iron shapes and the rolling of bars, plates and merchant steel shapes.—*Industrial World.*

Mechanicians Wanted, Not Gunners.

"Please, sir," says a midshipman who has groped his way to the engine-room, "the first lieutenant wishes to speak to you." The engineer officer has no colleague and has seventy men to look after. But the first lieutenant's will is law, so he leaves them to do their work and hurries up on deck. He is the only officer who can meet a difficulty in the other mechanical gear of the ship, and one of these has just been reported. The first lieutenant, smooth-shaven, frock-coated, and clerical, is waiting. By him stands a seaman-gunner, hat in hand, looking meek and injured.

"Something has gone wrong with the starboard quick-firing gun, Mr. ——; please do what you can to put things straight"; and the first lieutenant strolls off. "Well, Harris, what's the matter?" "Please, sir, we've 'ad a haccident, sir." "Well?" "We was just a-heaving up that 'andle, sir, when we noticed a bit of a 'itch, and then one of the cog-wheels, sir, that took and broke." "Oh! who was with you?" "Tim Sullivan, sir." "Send him here." Sullivan, a genial but untruthful Irishman, shuffles forward. "How did this accident happen, Sullivan?" "Begorra, sorr, wait till I tell ye; the more we heaved at the lever, the more she [the gun] would not stir, so we got a handspike in, and then the dirthy cog-wheel was entoirely scattered, sir."

The engineer goes to inspect the cripple, and finds that the mountings have not given way without cause. The fittings show signs of drastic treatment with the handspike. He also discovers the reason of the "'itch," an iron nut which has stuck in the wheel, and could have been removed in thirty seconds, had it occurred to the men to look. What occurs to our officer is that if Harris and Sullivan had had a little mechanical training instead of spending eighteen months, at a cost to the nation of £70 apiece, on a training brig learning to furl sails and tie knots, they would not have treated a machine gun like an ancient thirty-two pounder.—*The Spectator.*

Notes on Machine Design.

BY D. C. WOODWARD.

LATHE SPINDLE.

It requires no prophet to say that the time is fast approaching when nearly two-thirds of the work that is now turned upon a mandrel, between the centers of a lathe, will be finished complete while held by a chuck on the end of the spindle. This is shown by the present great demand for screw machines, chucking and turret lathes.

There are so many advantages in working upon a piece held in a chuck, that it would seem strange that more work was not at present finished in this manner, if it were not known how weak a point in lathe construction the spindle is.

When a very long and heavy piece is held in a chuck, and the tool is cutting at the extreme end, there are very severe strains upon the spindle and its bearings, which must be overcome by increasing the size of the spindle. This is recognized as true by all lathe builders; for, as each brings out a new lathe or makes changes in the old style, he increases the diameter of the front journal from $\frac{1}{16}''$ to $\frac{1}{4}''$. Truly this is a *wonderful* (?) improvement, but it points toward what must eventually come.

The spindle may be considered as a beam supported by the front journal, and the shape for uniform strength of such a beam would be two cubic parabolas placed base to base with the apex of one at the center of the rear journal, and the apex of the other at the front end of spindle. The strength, if solid, and length the same, is proportional to the cube of the diameter. Hence, of two spindles, one 3″ in diameter, the other 6″ in diameter, the second will be eight times as strong as the first.

The dotted lines, Figs. 1 and 2, show the parabolic curve for rear end of spindle.

Fig. 1 shows the spindle of a 16″ lathe, previously mentioned, which had a taper attachment head-stock. The front journal is larger than usual for a 16″ lathe, but the spindle is so much reduced in diameter at the point *A* that it is very weak. This clearly demonstrates how a step in the right direction may be more than counterbalanced by one in the wrong.

Fig. 2 is a section of a 17″ lathe spindle recently built, and which proves to be all that the manufacturer could wish. On each spindle is shown a 12″ chuck, holding a Corliss engine valve bonnet. The diameter of front bearing (Fig. 2) is 5″, and the length $5\frac{1}{2}''$.

Several important advantages are gained by having so large a journal beside mere strength. The vibration of the spindle in its bearing will be so much reduced that very smooth work may be done with coarse heavy cuts, and the hole through the spindle may be made large enough for something beside knocking out the center, which is very important in screw machine and turret lathe work.

If so desired, the spindle may be cast, and the hole through it cored, making the cost very much less than to drill from the solid.

As to the desirability of cast-iron for spindles, there is a difference of opinion, but several first-class manufacturers have adopted its use on large spindles, and with excellent results.

Fig. 1 has a $\frac{5}{8}''$ hole through the spindle, used only to fasten and remove the center, while Fig. 2 has a $2\frac{5}{8}''$ hole for $2\frac{1}{4}''$ rough stock.

Some may object to such large spindles on account of increased friction, but the decrease of friction, from a source to be noted later, in addition to so many other decided advantages, renders this slight increase worthy of no consideration.

It is unnecessary to lengthen the journal and retain the same ratio of length to diameter that is generally used, for at present most manufacturers make the front journal long enough, and all that is needed is to make the diameter as it should be. To obtain a front journal suitable for a manufacturer's lathe, make it in about the following proportions, keeping the diameter and length in half inches, as that fraction is small enough.

Make the diameter equal to about three-tenths of the swing of the lathe, and the length equal to the diameter plus $\frac{1}{2}''$ or 1″.

From this, for the majority of lathes, the front journal would be as follows:

	in.	in.	in	in	in.	in.	in.	in.	in.
Swing	8	10	12	13	17	19	21	25	30
Diam. of Journal	2½	3	3½	4	5	5½	6	7½	9
Length of Journal	3½	4	4	4½	5½	6	7	8½	10
Hole through Spindle	1 1/16	1 5/16	1⅝	1⅞	2⅜	3⅛	3⅝	4¼	6

These may seem large now, but it will be less surprising to find lathes in the future with larger than with smaller spindles.

With a hole through the spindle, of the size indicated by the table, the rear journal will of necessity be nearly as large in diameter as the front journal, but the length may be equal to or even less than its diameter.

A straight journal, with the bearing fitting a taper hole in the head-stock, as shown in Fig. 2, is far superior to a taper journal with the outside of the bearing straight. If from any cause the spindle moves endwise in the bearing with taper journal, it is either free to vibrate and produce chatter marks, or else it binds, and is liable to cut and stick to the bearing. With the straight journal no such bad results follow an end motion, while better adjustment can be had, and the cost of manufacture will be less for first quality work. The end thrust of the spindle should be taken by a collar similar to *C*, Fig. 2, which is of steel, hardened and ground, and thin enough to prevent any perceptible difference in the fit, whether cold or as warm as it is safe for a journal to become. The front and rear journals and thrust collar should be ground on dead centers, without removing from the grinding lathe until all are finished. The end of the spindle should be turned, and the thread cut after the spindle is placed in its final position. The thread should be cut as coarse as the U. S. Standard, and the end of the thread left square, both on the spindle and in the face-plate, so as to keep each other free from dirt. The face-plate should fit the spindle loosely in the thread, and should depend on the fit at the points *D* and *E*, Fig. 2, for accuracy of position. The spindle, Fig. 1, depends upon having the face-plate fit two tapers, which is a practical impossibility.

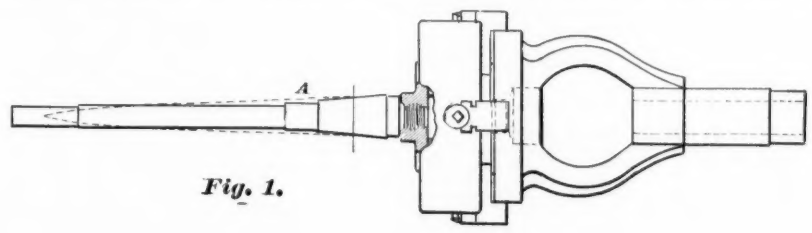

Fig. 1.

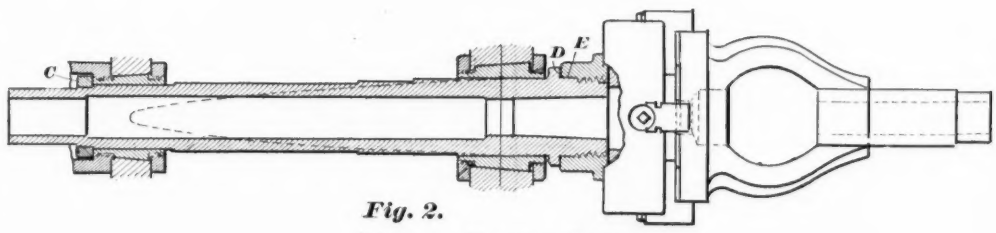

Fig. 2.

NOTES ON MACHINE DESIGN.

The number of newspapers published in all countries is estimated at 41,000–24,000 appearing in Europe. Germany heads the list with 5,500; then comes France with 4,100, England with 4,000, Austria-Hungary with 3,500, Italy with 1,400, Spain with 850, Russia with 800, Switzerland with 450, Belgium and Holland with 300 each, and the rest are published in Portugal, the Scandinavian, and the Balkan countries. The United States has 12,500 newspapers, Canada has 700, and Australia also 700. Of 300 journals published in Asia, Japan alone has 200. Two hundred journals appear in Africa, and three in the Sandwich Islands. In the principal languages there are published 17,000 newspapers in English, 7,500 in German, 6,800 in French, 1,800 in Spanish, and 1,500 in Italian.—*London Times.*

A Big Railroad Scheme.

A bill has been introduced in Congress to authorize the construction of a tunnel under New York bay. This is part of a plan for providing a Brooklyn terminus for railroads now finding stopping places along the New Jersey shore. The plan is to start from the Arthur Kill, cross Staten Island to a point about one mile from Stapleton, where the tunnel will begin. The tunnel will be about 2½ miles long, and is estimated to cost $1,250,000 per mile. The entire enterprise, in which Mr. Erastus Wiman is intimately concerned, is estimated to cost $6,000,000, and he believes the saving in the price of coal to Brooklyn would pay the interest on such an investment.

Sketches of an Apprenticeship.

BY W. S. ROGERS.

IV.

A friend has told me that he does not favor that slang expression used by cubs and jours almost universally when referring to the proprietor as the "Old Man." He says it is lack of respect, while I claim differently. The height of every worthy cub's ambition is to some day be the Old Man of some plant. And in after years, when accidentally overhearing his employes refer to him as the Old Man, his memory carries him back to the time when he was trying to secure a hold on the bottom rung of life's ladder.

That reminds me of one of my mishaps. My hardest work was learning the names of the different tools I had to use. I was always in trouble over it. One hot summer day I was with two of the men on an outside job, two miles from the shop, and they told me to go back and get a $\frac{9}{16}''$ drill, the ratchet, and old man. (For the benefit of the uninitiated who happens to read this sketch, I will explain that the "old man" in this instance refers to an angular piece of iron that is used in connection with the ratchet and drill.) I trudged back to the shop, and the first one I met, as I entered, was the proprietor. "How are you boys getting on with that job?" he asked. "First rate. John told me to bring you out, and also the—the—I forget their names, but some tools," I replied. "Bring *me* out!" he ejaculated; "what for?" I couldn't tell, of course; and having put on his coat, with a frown on his face that boded no good to those luckless fellows that were going to have him walk two miles in the broiling sun, he asked me what tools were wanted, but I could not remember. "Can you make a picture of them?" he asked. Yes, I could do that. So, taking a piece of chalk, I drew a tolerably decent representation of the ratchet on the shop floor. "You want the ratchet," he exclaimed. "What size drill?" "Nine-sixteenths," I replied.

To the tool-room we went, and handing me the ratchet and drill, he said, "Come on!" but I waited. "I want the other piece that goes with it," I said. "Oh, you want the 'old man,' too; why didn't you say so?" said he. And while he was getting that piece of angle iron for me there was a great light dawning on my brain; and when he handed it to me, I looked him fair in the eyes, and said: "*Mr.* Smith, John don't want you to come now." As I saw the smile that wrinkled up the corners of his mouth I knew he thoroughly appreciated and enjoyed his prestige as the Old Man.

Bring out all the improvements brain can devise in machine shop practice. Let everything be of modern perfection, but don't modernize the Old Man. Let him be still, as of yore, determined to have none but the best of workmen about him, and still more determined to make his apprentices capable craftsmen. Above all things, respect the Old Man as The Old Man.

Our New York correspondent telegraphs the cheering fact that the Teutonic has just beaten the record by thirteen minutes in a race across the Atlantic. There were only two starters, and the City of New York, which was the other, was three hours behind her rival. Did this proud vessel hesitate to burn a cargo of bacon at the critical moment? or did her Captain wisely prefer defeat to the risk of blowing his ship into the air? Every one must hope that we may have long to wait for the inevitable result of these contests, but no one can doubt that it will one day startle us with a tale of horror exceeding all others of the kind. It is now but five days nineteen hours and five minutes between Queenstown and Sandy Hook, where it was as many days and hours and eighteen minutes before. The odd five minutes, however, can hardly fail to break the repose of some adventurous captain. When these are knocked off the record, we shall, perhaps, have a fated conjunction of the hour and the man that will send a shock of agony through both worlds.

The above, from the *London Daily News*, expresses an opinion very generally entertained, that the quick passages of transatlantic steamships carry with them an element of danger to the passengers. It is doubtful if the lives of the passengers on one of the racers are endangered in any greater degree than on a slow-going boat. The "tremendous pressure" we read so much about in accounts of quick passages is tremendous nonsense. The effort is made to keep to the pressure controlled by the safety valves, and that is all there is of it. The idea that a vessel that is given extra engine power shall loaf along like one that is deficient in this respect is a good deal like keeping a passenger train at freight train speed. The fast boat is probably the safer one.

Concerning the influence of sea water on Portland cement, M. E. Candlot says: "The nature and quantity of the water used are of influence on the setting of cement. Sea water, by forming calcium chloride and sulphate, by double decomposition of the magnesium salts it contains, with the lime compounds present in the cement, retards the setting. Neat cement gauged with sea water is at first stronger than when fresh water is used, but retrogrades after some months. Cement, when made up into mortar by admixture with sand, shows no such tendency; the use of sea water may delay its reaching its full strength, but this is attained after the lapse of a year. This fact applies particularly to finely ground samples."

A little science is a wonderful, if not a dangerous thing; for example, a daily paper in a city near New York has discovered that the so-called water gas, used to some extent, is responsible for the death of the shade trees. It would be interesting to know what is in or of the water gas that is deficient in other gas, that brings about such disastrous results.

What is known as the Chicago Polytechnic Institute has been opened at Chicago, Ill. It is modeled after the London Polytechnic Institute, and with its forty departments the intention seems to be to teach young men about a good many of the common things of life, including something of many trades. The school will be open day and evening.

A Powerful Light.

An English paper says: Usually we look to America for the biggest things on earth, but, strange to say, although the Americans are the most extensive users of electricity, the most powerful artificial light in existence is the property of the English Government, and is to be found in the Isle of Wight. The lamp referred to is that of the lighthouse of St. Catherine's Point, where there is also a powerful fog-horn. The plant has three engines of 36 horse-power each. Two of these are used for working the dynamos, and the other for the fog-horn. The current is conducted by wires across a road direct from the dynamos to the lamps, there being no accumulators. The light is obtained from a carbon lamp of special pattern. The ordinary light is equal to three million candles, but a light of six million candle-power can be and has been obtained. It is impossible for any one who has not seen it to imagine the wonderful brilliancy of the light, but some idea may be formed from the fact that it can be distinctly seen forty-five miles away, and that at the Needles, fourteen miles distant, it is quite easy to read very fine print by means of the reflection. On one side of the lamp room is a quantity of very thick glass for repairing the windows broken, not by storms so much as by wild ducks and sea birds which are attracted by the light. A singular feature of the lighthouse tower is a plummet and line hanging from the ceiling of a lower chamber, the plummet pointing to a spot on the floor. This is for the purpose of enabling the man in charge to tell when the tower is out of the perpendicular. The lighthouse was built on an under cliff, formed by a gigantic landslip which occurred in 1799, and some portions of this cliff are still slipping.

If every coroner would tackle the subject as Coroner Rooney, of Brooklyn, did in the case of a woman recently killed on the Long Island Railroad, trains would be run with greater care. He said, in addressing the jury:

That was nothing but murder, and it is the sixth murder that has been committed by this company since 1890 began. The next time such a thing occurs the officers of this company shall be arrested and lodged in jail on my order as coroner of this county. Every day and every hour of the day this company is violating the law by running trains too fast through the city streets, and by leaving these unguarded openings in the fence, through one of which this poor woman entered. You, gentlemen, should regard this feature of the case.

A German photographer has been experimenting for several years in photographing the flight of cannon balls, and has at last succeeded in a way that possesses a good deal of scientific interest. He calculates that the duration of the light thrown on the plates was not more than the ten-thousandth part of a second.

Machinists' Supplies and Iron.

NEW YORK, Sept. 20, 1890.

Iron—American Pig—There has been no change of importance since our report of last week. The demand has been of moderate proportions; the offerings of standard brands are about equal to the requirements of buyers. There has been some disappointment that the demand for finished iron has not improved.

We quote standard Northern brands, $17 to $18 for No. 1 Foundry; No. 2, $16 to $16.50; Southern brands of good quality can be obtained at $16.75 to $17 for No. 1 Foundry, and $15.75 to $16 for No. 2.

Scotch Pig—The demand has been of a retail character, and the sales were confined to small parcels from store to meet current requirements of regular customers. Importers ask $24 for Coltness; $21.50 to $22 for Dalmellington, and $19.50 to $20 for Eglington.

Bar Iron—The demand has somewhat improved, but without quotable change.

We quote Common, $1.85; Medium, $1.90; Refined, $1.95 to $2 for round lots on dock.

Plates—The demand has improved, and is firmer.

We quote Common Tank, $2.25 to $2.30; Refined, $2.35 to $2.45; Shell, $2.35 to $2.45; Flange, $3.40 to $3.45; Extra Flange, $3.60 to $3.75.

Lead—The market has ruled firm, but quiet; the sales were chiefly in small lots for current use; large consumers showing very little disposition to replenish their stocks. In most cases holders ask 5.05c. to 5.07½c. for prompt and near delivery.

Spelter—The demand for Western has been moderate, and the market has ruled steady, with prime brands offered at 5.70c. to 5.75c.

We quote ordinary brands Western, 5.55c. to 5.60c.; choice, 5.70c. to 5.75c.; refined, 6¾c. to 7c.; Silesian, 7¼c. to 7½c.

Tin—Speculative influences have caused a further advance in values both here and in London, cable quotations from the latter being £101 7s. 6d. spot, and £99 17s. 6d. futures, but prices here have been quite irregular, and much of the business has been transacted at prices below the values nominally quoted, and it is claimed that the market has been artificially sustained in order to afford the bulls an opportunity to work off their supplies. The market is unsettled.

Antimony—There has been no change in the value of Regulus; the trade is reported as moderate.

We quote: Hallett's, 19⅞c. to 20c.; L. X., 20¾c.; Cookson's, 22c.

Copper—There has been a fair inquiry for Lake, and the market has ruled quite steady.

We quote 25c. to 50c. for sheathing copper; 25c. to 30c. Brazers; 25c. for bolts; and 29c. to 32c. for Bottoms; for American yellow sheathing and nails, 17c.; rods, 19c., and English in bond, 12c. Casting brands are attainable at 14½c. to 14⅝c.; and Arizona at 15⅛c. to 15¾c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Position as engineer; thoroughly competent, sober and reliable. Box 71, AM. MACH.

Mechanical draftsman wants position in New York or vicinity. Address K., AMERICAN MACHINIST.

Wanted—Experienced steam pump salesman. Buffalo Steam Pump Co., Buffalo, N. Y.

Wanted Immediately—A foreman blacksmith. Address E. J. Codd Co., Baltimore, Md.

Experienced mechanical draftsman desires position. Mechanical, 432 Monmouth st., Trenton, N. J.

Wanted—Two or three bright machinists who desire to advance. Straight Line Engine Co., Syracuse, N. Y.

Wanted—Experienced draftsman, with large company in Pennsylvania, building engines and rolling-mill machinery. Box 72, AM. MACHINIST.

Wanted—At once, two first-class machinists; steady, sober men can find work at good wages. Bluefield Iron Works, Bluefield, W. Va.

Wanted—Good machinists, especially planer hands. Bement, Miles & Co., 21st and Callowhill streets, Philadelphia, Pa.

Experienced mechanical draftsman with shop experience and tech. education wants position; N. Y. City or vicinity. Address Box 78, AM. MACHINIST.

A draftsman and mechanical engineer wants the designing of light machinery and tools for manufacturing to do. Box 75, AMERICAN MACHINIST.

Wanted—By a first-class brass finisher, a position as foreman in a brass finishing department. Best of references. Address, Dwight, AM MACHINIST.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Wanted—Two good metal pattern makers, on iron pipe fittings and brass valves. Address, stating wages and experience, The Kelly & Jones Co., Greensburg, Pa.

Wanted—Young man, posted and some experience, to travel locally frequently and sell machinists' supplies, oils, etc. Salary $60 per month and expenses when on the road. Clarksburg, AM. MACH.

Wanted—Foreman for machine shop in a large city in Wisconsin; must be posted on Corliss engines and refrigerating machinery; one speaking German preferred. "M. W. J." AM. MACHINIST.

Wanted—Situation as master mechanic or chief engineer. Has indicator, etc., of his own. At present employed. Good reasons for changing. Address, C. F. B., AMERICAN MACHINIST.

Wanted—Situation by tool maker understanding the designing and construction of small machines and tools, capable of taking charge of and turning out work cheap. Box 77, AMERICAN MACHINIST.

Wanted—A first-class draftsman and mechanical engineer as superintendent of foundry, machine and boiler works. Address with reference, stating salary expected, Boilers, AMERICAN MACHINIST.

A college-educated draftsman, with experience in designing and building automatic compound steam engines, vertical and horizontal, can find employment with a large engineering establishment in Pennsylvania. Address Box 73, AM. MACHINIST.

Wanted—Position by engineer and draftsman, experienced on general and automatic machinery, cable rai roads, steam power plant (detail), structural iron work; 4 years' experience as civil engineer. A., 208 East 118th st., N. Y., care of Graves.

BRADLEY HAMMERS AND FORGES

BEST HAMMERS IN THE WORLD RUN BY BELT

OVER 1500 IN USE.

Three Styles, 15 lb. to 500 lb. Heads.

Our FORGES heat irons fast enough to keep Hammers and Men fully employed. Send for Catalogue and Prices.

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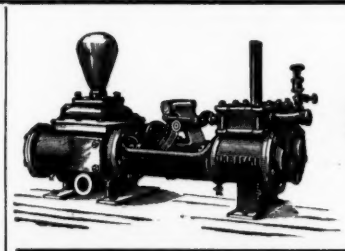

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BOOKS FOR MOULDERS,

West's American Foundry Practice, $2.50

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Mailed and prepaid on receipt of price.

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foreign brands of steel should not forget that while they have been perfecting their own tools we have not been standing still. Our Tool and Die Steel is second to none.

CRESCENT STEEL CO.,

64 & 66 SO. CLINTON ST., Chicago, Ills. 136 FIRST AVENUE, Pittsburgh, Pa. 480 PEARL STREET, New York, N. Y.

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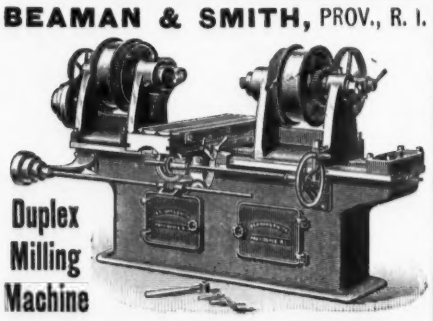

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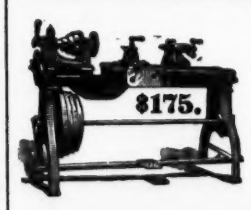

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Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Spring wire.

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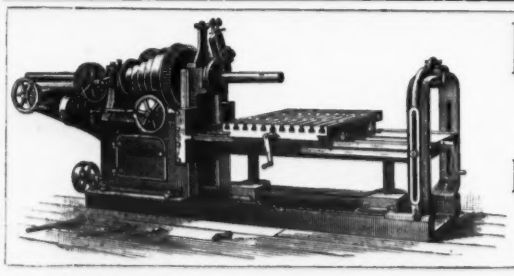

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Wanted—A few good, industrious and sober machinists and molders on mining and saw-mill machinery and engines; permanent places and highest pay; married men with families preferred; beautiful and healthy location; good homes and schools; rapidly growing city. North Star Iron Works, Parish Mfg. Co., Ashland, Wis.

Wanted—A young man, thoroughly competent to act as foreman in mach. dept. in shop mfg. steam eng's and saw-mill mach.; must understand managing men, and modern methods of doing work; good character and habits essential; would have charge of 25 to 50 men; one familiar with indicator practice preferred; state age, experience, and where formerly employed. O. C., AM. MACHINIST.

Wanted—A first-class foundry foreman in Atlanta, Ga.; a man who thoroughly understands management of men, mixture of metals and general foundry work; first-class wages will be paid; none need apply who are not thoroughly competent in every respect, as their incompetency would be soon known, and would be a loss to them and ourselves. Address, with reference, Box 259, Atlanta, Ga.

Wanted—Two copper plate engravers; one expert in lettering and stipple or sand tinting as shown on coast and geodetic survey charts; salary $1,800 per annum; and one with less experience; salary $900 per annum. Also expert engravers of topography and stipple or sand tinting, to contract for work to be done at their homes. Further information will be furnished on application. T. C. Mendenhall, Superintendent, U. S. Coast and Geodetic Survey, Washington, D. C.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d-hd lathes & planers. S M York, Clev'd, O.

Koopman's Scales for quick measurements.

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New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Wanted—Customers for our new Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

For Sale—Cheap, one 1½-inch Schlenker Bolt Cutter. Address Capitol Mfg. Co., Chicago, Ill.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

For Sale—At a bargain, 12-inch pipe-cutting machine, with expanding dies. Address X. Y. Z., 245 South Third street, Philadelphia.

Wanted—To correspond with reliable parties in the steam engine business, with a view to introducing a new shaft governor. Governor, AM. MACH.

For Sale—A two horse-power C. & C. Electric motor, almost new. Central Bureau of Engraving, 30 Vesey street, N. Y.

Wanted—To form a company to build machine tools, by party with shop and machinery. Address BOX 79, AMERICAN MACHINIST.

For Sale—Foot-power screw-cutting lathe, swings 6x18, cuts threads 5 to 40, self-centering chuck, and some tools. W. H. C., Box 526, Newton, N. J.

Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

Wanted—Engineers to write for Catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Boiler Shop for Sale—In a town of 15,000 inhabitants in Kansas, a new boiler shop, 48x96, thoroughly equipped with modern power tools; on three trunk lines of railroads, with private switch; no competition within one hundred miles; easy terms to buyer. Address "Kansas," AMERICAN MACHINIST, New York.

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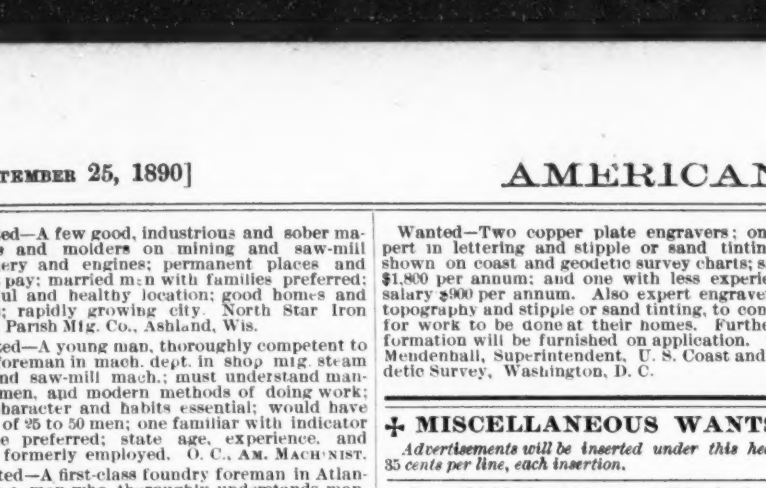

The above cut is taken direct from a photograph of an iron roof built by us for The Ansonia Brass and Copper Company, at Ansonia, Conn., and now in use over their rolling mill. The building is 110 ft. wide by 250 ft. long—the roof trusses being in one span and are designed to carry shafting as well as to lift the rolls in and out of the housings. By means of this roof any machinery used in this mill can be lifted or moved about the room.

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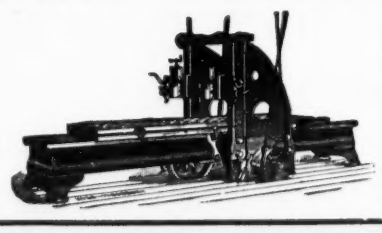

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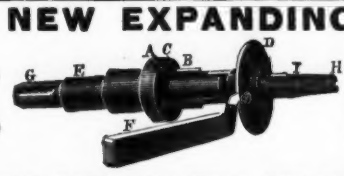

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5 "	3 " 4 "	44

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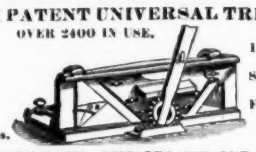

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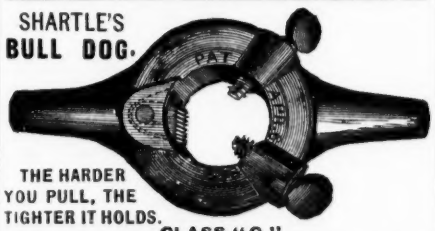

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CLASS "C."
This style is made from 1 in. to 8 in. or larger. Specially adapted to axle and roll turning, and Boring Bars. Guaranteed not to slip. Write for catalogue showing the different styles. MANUFACTURED BY
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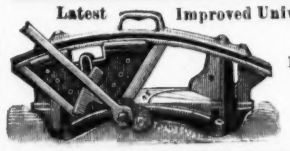

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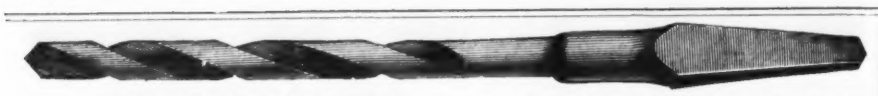

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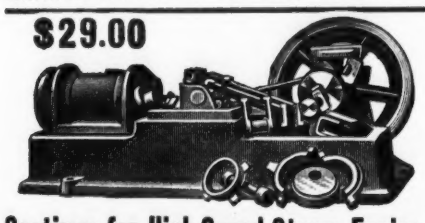

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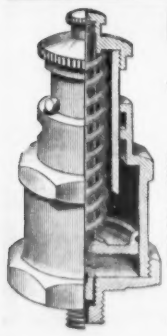

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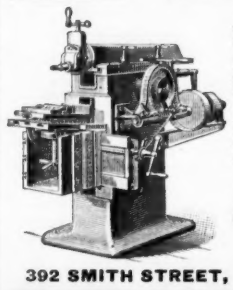

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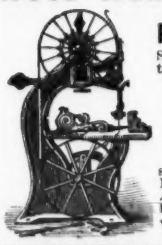

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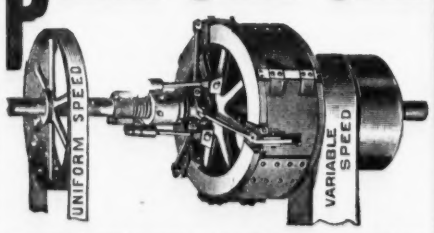

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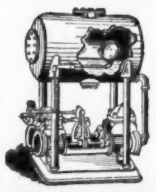

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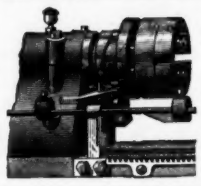

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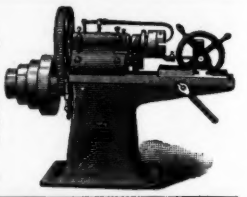

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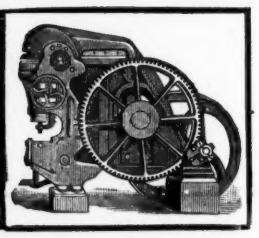

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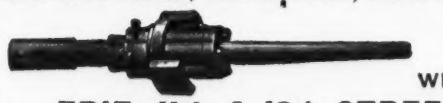

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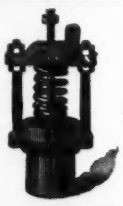

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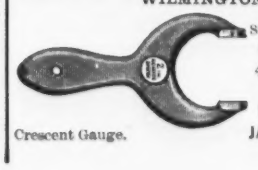

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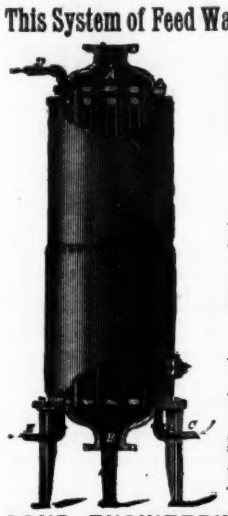

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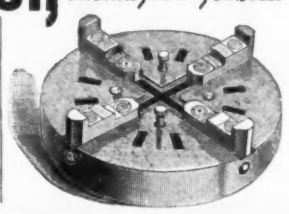

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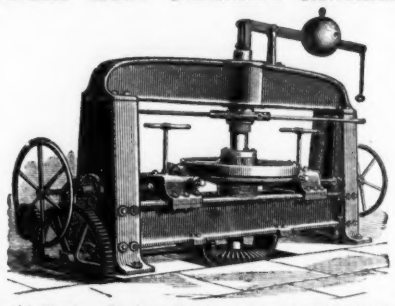

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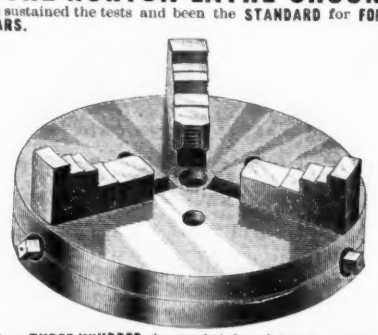

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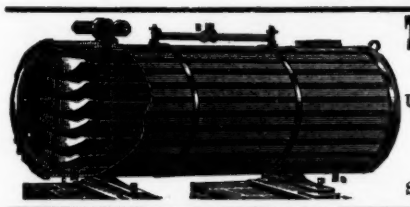

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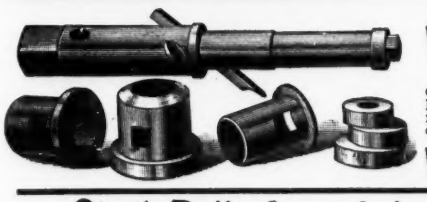

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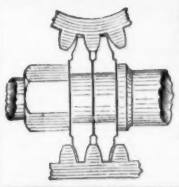

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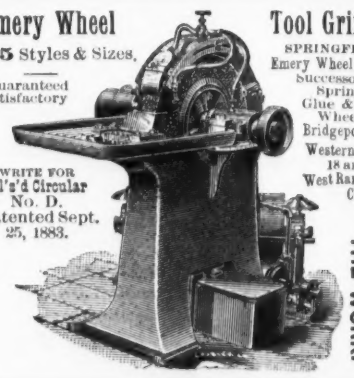

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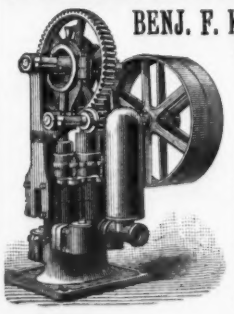

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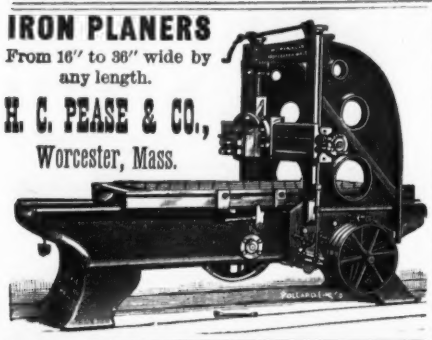

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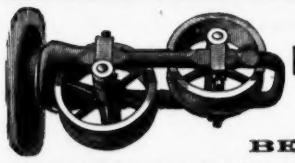

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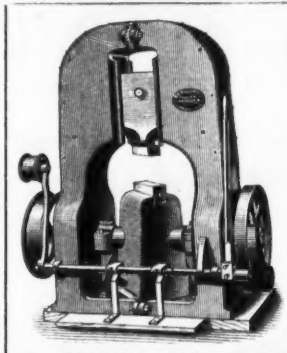

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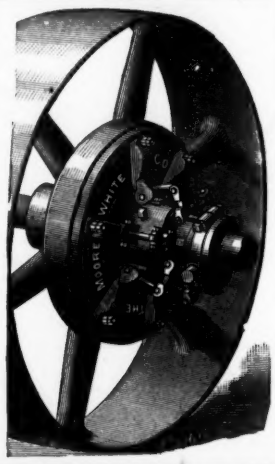

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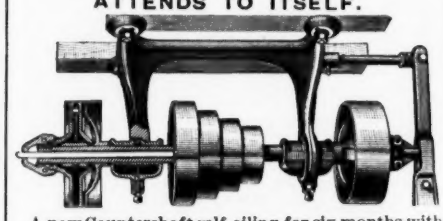

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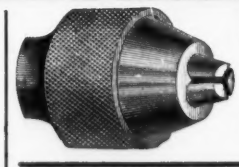

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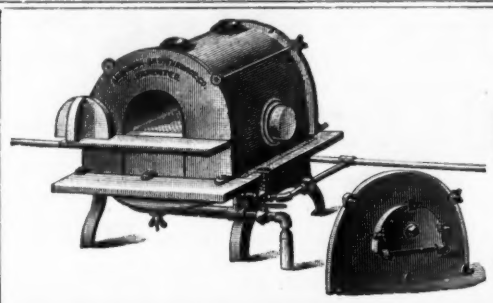

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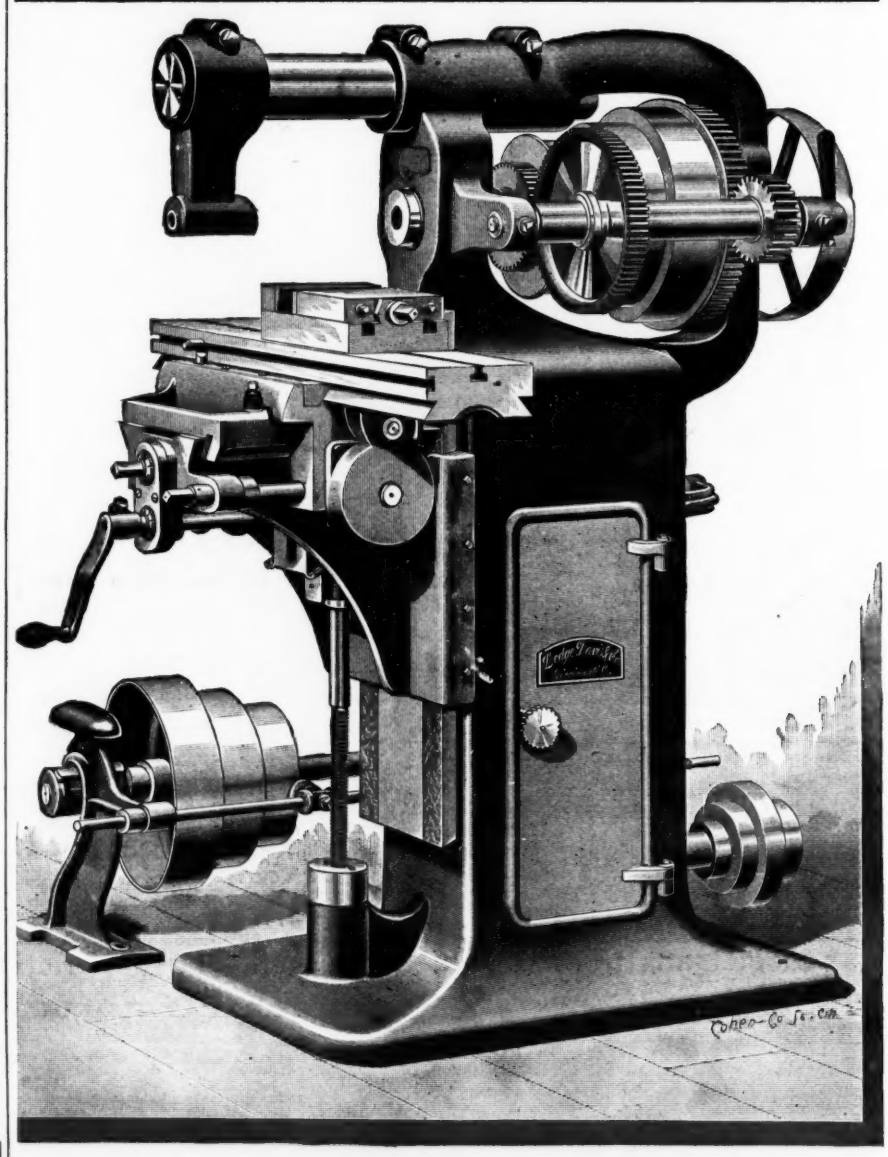

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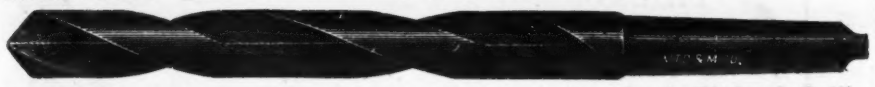

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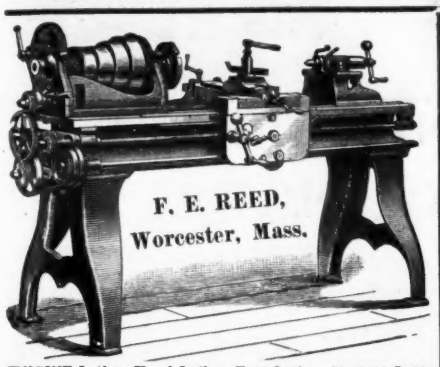

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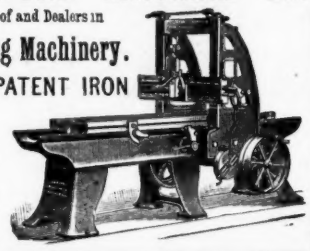

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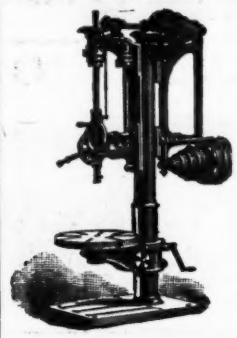

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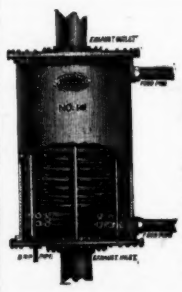

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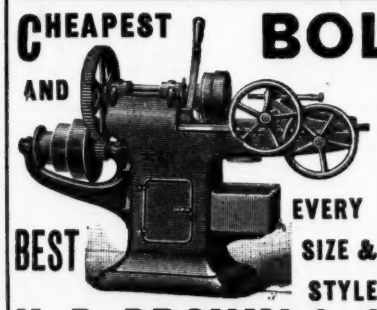

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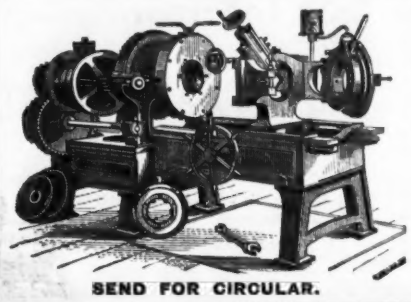

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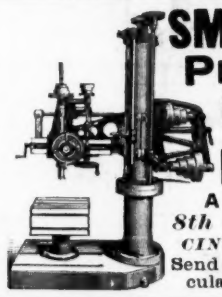

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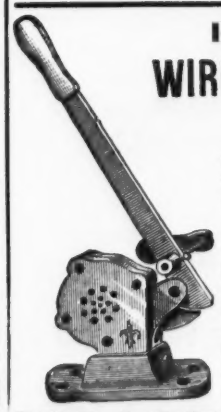

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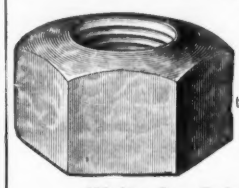

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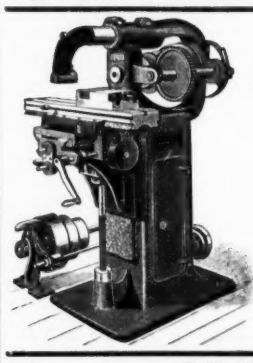

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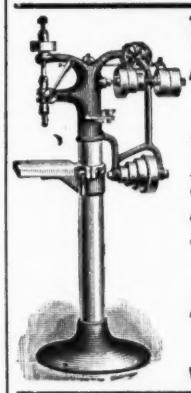

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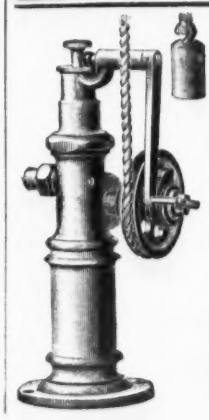

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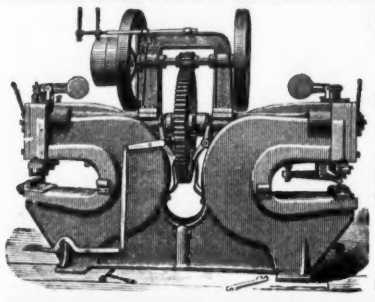

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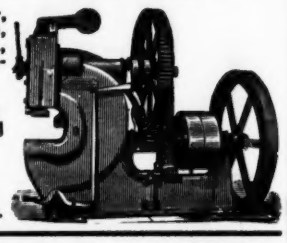

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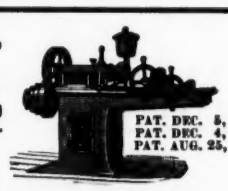

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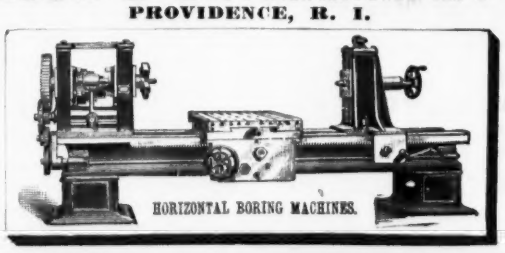

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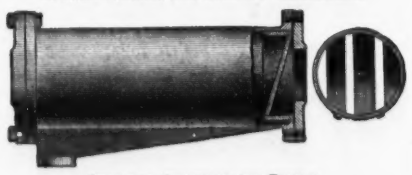

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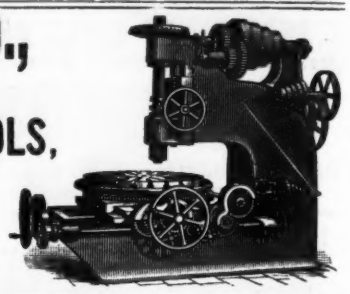

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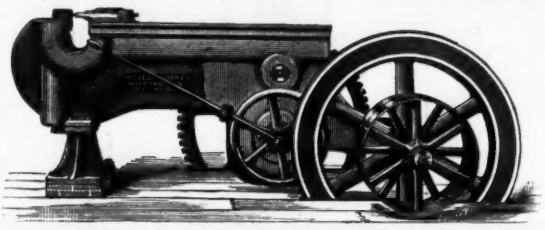

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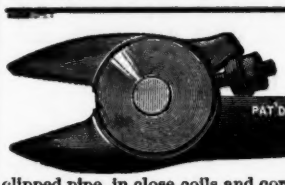

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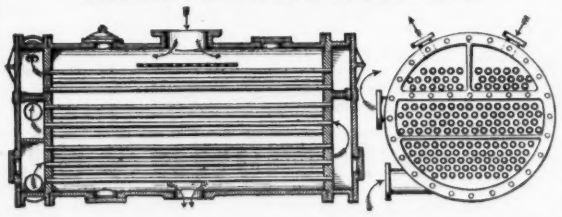

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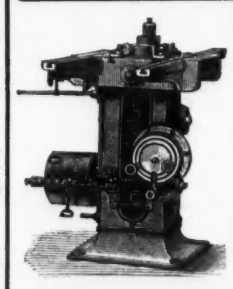

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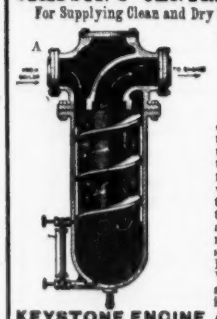

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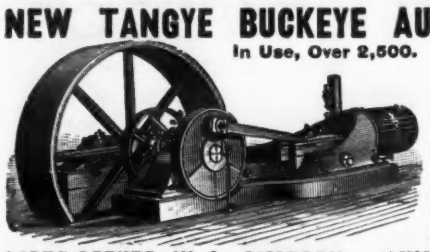

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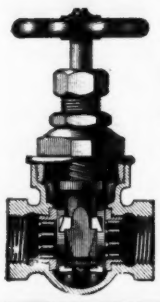

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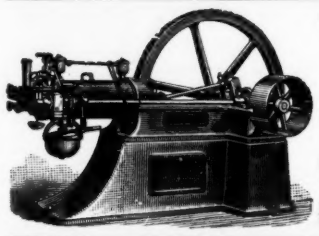

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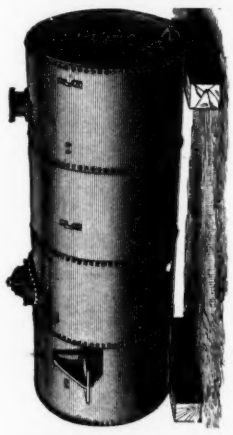

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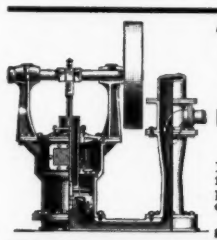

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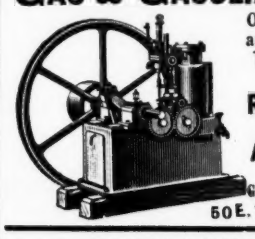

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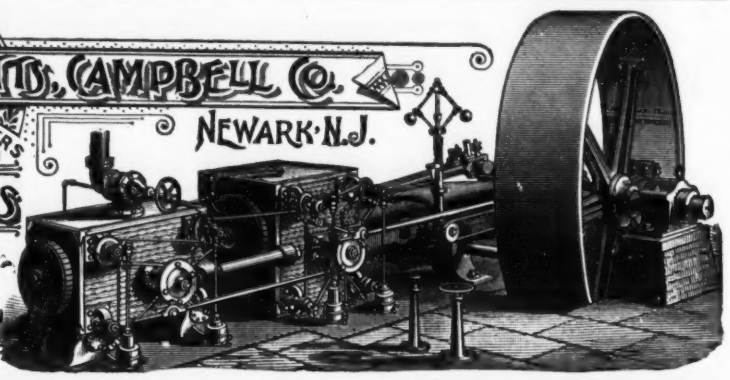

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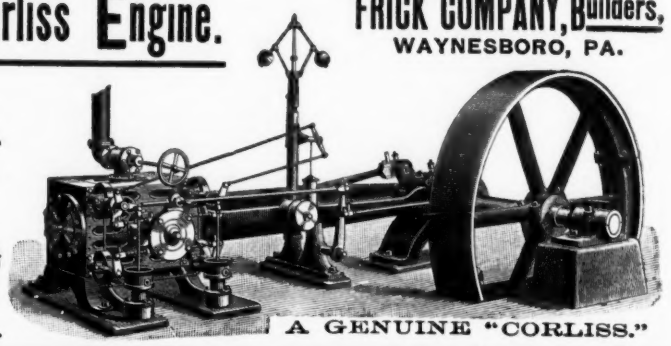

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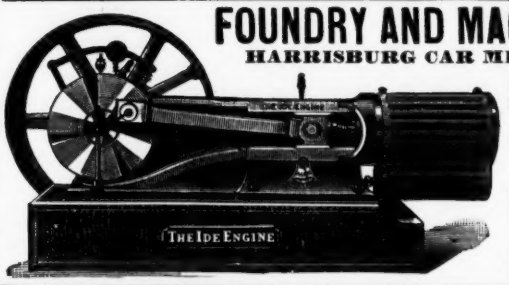

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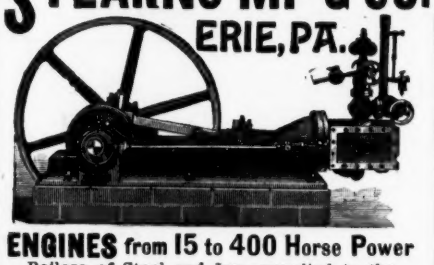

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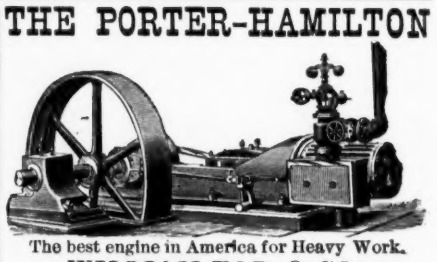

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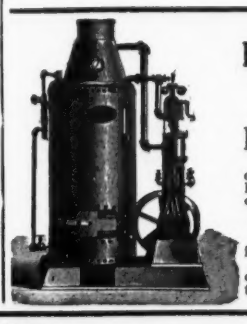

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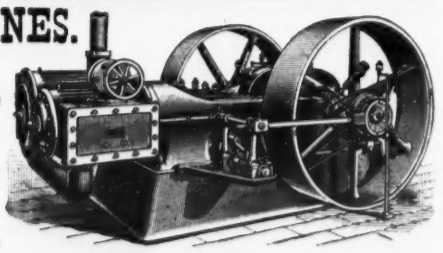

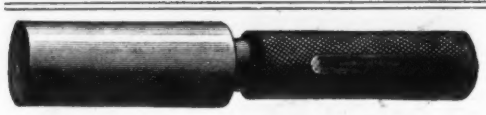

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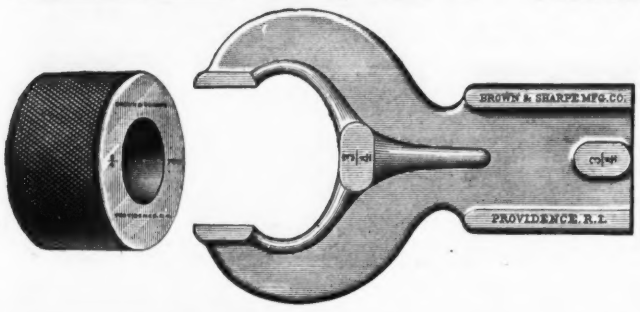

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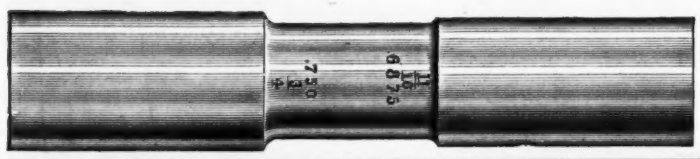

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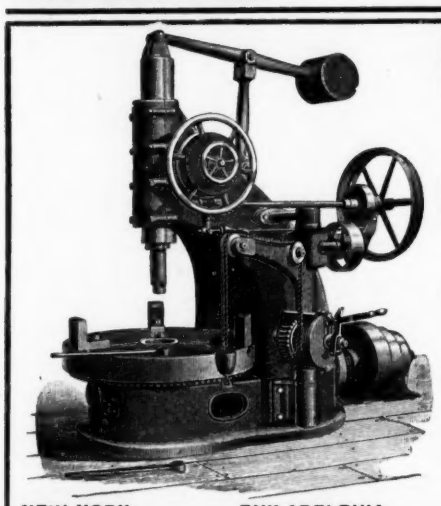

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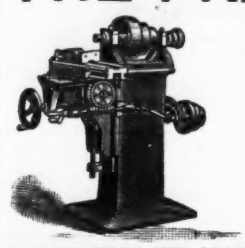

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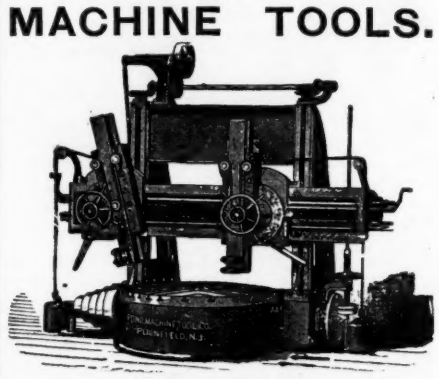

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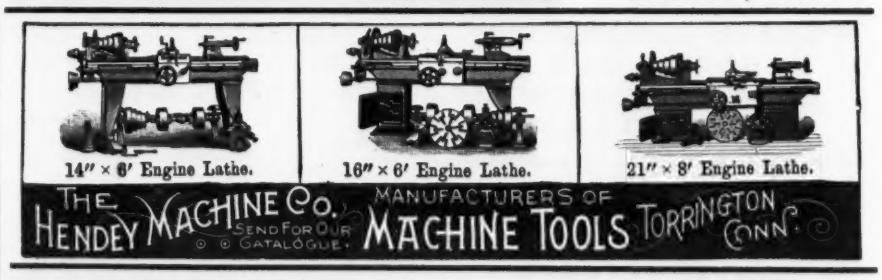
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